CHT SHIP/SHORE OPERATIONS ASSESSMENT

VOLUME I

DECEMBER 1978

APPROVED FOR PUBLIC RELEASE:
DISTRIBUTION UNLIMITED

PA Engineering
PROFESSIONAL ENGINEERS

5643 PARADISE DRIVE
CORTE MADERA, CA 94925
(415) 924-8587

8

6

CHT

SHIP/SHORE OPERATIONS

ASSESSMENT,

VOLUME I,

by

10

R. W. Urban,

P. E. Carr,

S. H. Schwartz

PA Engineering

Corte Madera, California 94925

and

Norfolk, Virginia 23510

15

CONTRACT NUMBER: N00014-78-C-0345

Project Officer

Scientific Officer (Code 230)

Office of Naval Research

800 N. Quincy Street

Arlington, Virginia 22217

12 110

11

8 Dec[redacted]78

411 104

PAGES______

ARE

MISSING

IN

ORIGINAL

DOCUMENT

EXECUTIVE SUMMARY

An evaluation of the Norfolk area CHT ship to shore sewage transfer systems was conducted during the past eight months. This evaluation examined most every aspect of CHT operation of both shore and ship systems. This report has two volumes. Volume I contains the final project report, Parts I and II, and Standard Operating Procedures for the shore systems for the three major Norfolk ports. Volume II contains reports on individual ships activated and studied during this program. The observations contained in this report are the result not only of the recent work in the Norfolk area but, also, work during the past two years in the San Diego area in activating and testing these systems.

Little over two years remain until the 1981 deadline requiring compliance with the DOD directive requiring the collection and treatment of shipboard generated waste. To meet this goal, the Navy is primarily relying on the installation of Collection Holding and Transfer (CHT) systems for most of its surface vessels. Installation of these systems is still progressing and most shore pier sewers are nearing completion. The program to install these systems has been primarily concerned with the engineering problems of design and installation. As more CHT systems become activated and shore systems are ready to receive sewage, the program to meet the 1981 goal is entering a new phase. This phase must be concerned with system operation. The CHT system must mature from an idealized design concept and installation to a practical, reliable shipboard operated system. To meet the goal, close attention must be paid to the experience gained during these early phases of system fleet wide activation. This experience must be acted upon and used throughout the fleet.

To meet the full activation goal it can be seen that program responsibility must shift to those levels more closely responsible for ship operation. COMNAVSURFLANT and COMNAVSURFPAC are taking an increasingly active role not only in system certification but in overall support of CHT operations. In addition, individual type commanders are increasingly aware of the requirements of the CHT system and are encouraging its activation and use.

The project in the Norfolk area examined more closely the volumes of wastewater produced from CHT equipped ships. The data was collected from a variety of ship types and has supported observations that the volumes from CHT equipped ships may be higher than the 60 gpcd design estimates. The data presented in this report shows that the daily wastewater volumes are not generally predictable and widely vary from each ship and particular day. An average of 8 ships produced over 2.4 times the 60 gpcd design estimate. The cause of these high volumes are the result of some design deficiencies and regularly occurring operator errors. The high volumes are of concern because of rapidly increasing wastewater treatment costs and the increased wear on CHT system components.

The successful operation of the CHT system depends almost entirely on the ability of the individual system operator to perform his job. With this in mind, several recommendations have been made for hardware and software improvements. These improvements provide more operator control and understanding of his system. Simple improvements like indicator lights, pump cycle counters, and tank level indicators will help the operator maintain and control his system.

The installation of each CHT system is unique enough to cause individual operators considerable apprehension before attempting a system startup. SDOSS documentation manuals provide some assistance. However, we have found "hands on" training to be the only way to overcome this apprehension and initiate safe and effective operation.

In evaluating the shore side systems, individual Standard Operating Procedures were developed for each of the three Norfolk area ports. They are: the Naval Amphibious Base, Little Creek; Norfolk Naval Station; and Norfolk Naval Shipyard, Portsmouth. These individual SOP's provide the shore system operator with additional information concerning the design and use of his system. In preparing these manuals we have included much of our experience with the ships' systems and how they interact on the shore side. Only in knowing something about the ship system operation will the shore side operator and utility personnel be better able to meet the needs of the ships.

Chapters deal with expected pier loadings and system capacities, routine procedures, emergency procedures, health and safety, and maintenance.

The individual SOP's in no way are intended as a final document for that system operation but are intended to encourage changes and updating as more experience is gained with ship to shore sewage transfer. These SOP's can be useful to other activities in examining their own ship sewage collection systems. Two unknowns to concern the shore side operators seem to be the effect of extreme cold weather operation, not only on hose and fittings but on under pier exposed sewer pipes and the accuracy and ability to measure wastewater from individual ships to keep treatment costs within budgetary constraints.

The next two years is a critical time for the CHT system and related shore facilities. During this time as many ship and shore operators as possible must become familiar with the system, and the "bugs" common to any new system must be worked out. More should be done to "sell" the system and its importance to operators and command levels. The system operator must understand the reason for the CHT system and that he is an important part in meeting the 1981 goal.

ACKNOWLEDGEMENTS

The CHT operations assessment program conducted in the Norfolk, Virginia area required long hours of system activations and evaluations over the six month period required to conduct the assessment. In all cases, the success of the entire program was primarily due to the cooperation and interest received from both the ships and shore side support activities involved in this project.

HTC Wisecarver of COMNAVSURFLANT was most helpful in scheduling and arranging access to the ships visited. Mr. Greg Sullivan of LANTDIVNAVFAC, Norfolk, was instrumental in acting as our liason with the various shore side activities.

The aid of the shore activities, particularly Mr. Walt Abbott and his crew (PWC, Norfolk), Ens. Larry Laws (PWD, Little Creek) and Lt. Tom Wisehart (PWC, Norfolk Naval Shipyard) enabled us to evaluate the engineering aspects of the pier sewer systems.

The ship activations and evaluations were only possible because of the cooperation received from the officers and crew of the test ships. The ships that participated were:

USS RICHARD E. BYRD (DDG-23)
USS BLANDY (DD-943)
USS VULCAN (AR-5)
USS FAIRFAX COUNTY (LST-1193)
USS DONALD B. BEARY (FF-1085)
USS PORTLAND (LSD-37)
USS PAPAGO (ATF-160)
USS SAGINAW (LST-1188)
USS RECOVERY (ARS-43)

TABLE OF CONTENTS

VOLUME I

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

PART I

SHIPBOARD INVESTIGATION

SHIPBOARD INVESTIGATION

1. INTRODUCTION

This part of the report describes the results of Sewage Collection Holding and Transfer (CHT) system field tests conducted on ships at the Norfolk Naval Station and the Little Creek Amphibious Base, Norfolk, Virginia, from May until September, under contract number N00014-78-C-0345. The objectives of these tests were to:

a. Collect and examine the daily sewage generation rates of U.S. Navy ships of various sizes and classes.

b. Identify the major sewage generators on each ship class and to determine the correlation between these generators and the total sewage generated.

c. Determine ways to reduce the sewage generated by U.S. Navy ships.

d. Assess operating procedures for single and nested ships.

The tests were performed using operating CHT systems on the following ships:

USS RICHARD E. BYRD (DDG-23)
USS BLANDY (DD-943)
USS VULCAN (AR-5)
USS FAIRFAX COUNTY (LST-1193)
USS RECOVERY (ARS-43)
USS DONALD B. BEARY (FF-1085)
USS PORTLAND (LSD-37)
USS PAPAGO (AFT-160)
USS SAGINAW (LST-1188)

Also conducted was a test which involved a two ship nest comprised of the VULCAN and the RECOVERY.

The primary task of this phase of the overall project was to collect sewage generation data from U.S. Navy ships. To obtain this goal, it was necessary to activate the CHT systems on the above ships.

This part of the report is divided into chapters which discuss the following specific areas of this project:

2. DATA ANALYSIS
3. SHIP ACTIVATION (SINGLE SHIP AND NESTED SHIPS)
4. HARDWARE
5. SOFTWARE
6. CONCLUSIONS
7. RECOMMENDATIONS

2. DATA ANALYSIS

The primary task for this phase of the overall project was to collect data concerning the sewage generation rate of a cross section of U.S. Navy ships. The data was collected by using the volumes of the collection tanks and the number of pump firings per selected time period. To check the computed volumes, the flow meters were installed in the discharge hoses and registered the volume pumped per pumping cycle.

Electric event counters (Figure 1) were wired into the pump control circuits. These counters registered the number of pump firings for a given time period. The total firings per time period were multiplied by the tank volumes to give the total gallons of sewage pumped per time period.

To obtain peak loadings during a specific time period, strip chart recorders (Figure 2) were also wired into the pump control circuits. These counters provided the actual time that the pump firing occured.

On some ships, ship's force personnel were used to collect the counter readings at regular intervals. This method had only limited success because of the human errors and the resulting data proved to be less reliable than that obtained by using the strip chart recorders.

The data collected during this project was compiled and condensed into the data presented in Table 1. More detailed daily and hourly data can be obtained from the individual ship reports that follow as appendices to this report.

The data presented shows CHT systems operating in various modes with unusual high volume wastewater sources indentified. As a result, methods to reduce excessive wastewater production have been identified. Chapter 6 of this part makes recommendations to reduce excessive wastewater production. The amount of reduction from each recommendation is estimated from the data in Table 1.

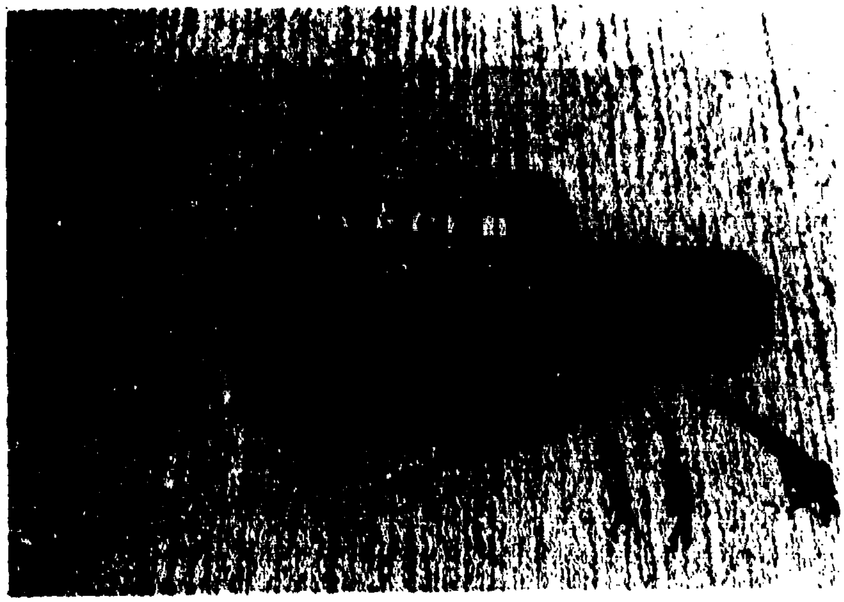


FIGURE 1. Electrical Event Counter

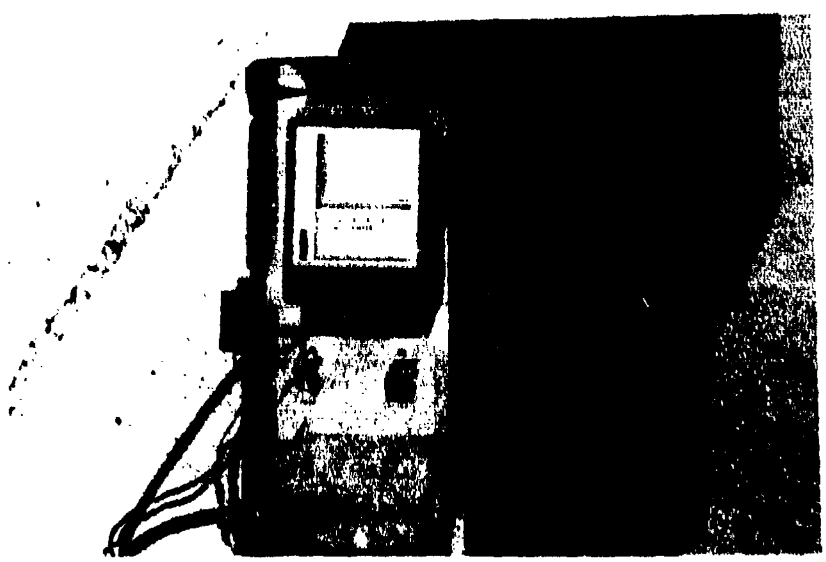


FIGURE 2. Strip Chart Recorder

DATA SUMMARY TABLE 1

SHIP	CREW (1)	NORMAL DAILY VOLUME gals	gpcd	CONTROLLED DAILY (2) VOLUME gals	gpcd	BLACK WATER DAILY VOLUME gals	gpcd	TRANSIT HOLDING TIME (1) HRS. FWD	AFT	URINAL CONSTANT FLUSH	LEVEL SENSOR FAILURE	SYSTEM INSTALLATION DATE
BYRD (DDG 23)	250	22,487	90	14,639	59	8,264	33	10.2	5.3	YES	YES	75
BLANDY (DD 943)	250	38,988	130	27,327	104	23,268	93	1.4	2.4	YES	YES	7/76
VULCAN (AR 5)	767	220,000	287	220,000	287	135,000	176	1.2	2.7	YES	YES	2/76
FAIRFAX CTY (LST 1193)	200	25,728	129	12,747	51	3,692	18	68.3	10.5	NO	NO	2/78
BEARY (FF 1085)	220	10,952	50	10,952	50	NA		NA	NA	NO	YES	1/76
PORTLAND (LSD 37)	387	15,010	39	10,486	27	5,247	14	7.5	50	NO	YES	12/75
PAPAGO (ATF 160)	55	5,550	101	5,550	101	4,125	75	NA	6.6	YES	YES	9/77
SAGINAW (LST 1188)	210	91,022	433	39,393	187	21,326	101	11.1	2.8	YES	YES	1/77
AVERAGE			157		108		73					
WEIGHTED DAILY AVERAGE			144		99		65					

Notes: (1) Without troops embarked on amphibious ships (2) Volumes measured with high volume sources secured by test personnel

2.1 Description of Data Table

The data presented in Table 1 was obtained by using the collection methods above. The crew size used in the calculations of this table was the average number of personnel assigned to the individual ships and did not include troops or other additional personnel who may be embarked on the various ships when deployed.

1. "Normal Daily Volume"--values for volumes observed before any controls were instituted during the tests. Contributing to these volumes were: (1) galley eductors left running; (2) planned and unplanned tank flushings. The volumes shown here can be construed as actual values where the operator is not aware of the high volume sources.

2. "Controlled Daily Volumes"--were obtained after the high volume producers were located and secured. In the Appendix ship reports, these volumes are referred to as "baseline volumes".

3. "Black Water Daily Volumes"--were measured by diverting the graywater drains over the side and collecting only the black water with the CHT system. This data gives the soil water generation rates which were used to determine the transit holding times for the individual ships.

4. "Urinal Constant Flush"--column shows which ships use constant urinal flushing and those that do not. Also, it allows the comparison of ships that do use the flush (Example-- the difference between the BYRD and BEARY).

5. "Level Sensor Failure" and "System Installation Date" columns are given for information purposes.

2.2 Analysis

The data collected was somewhat controlled because of the approach taken in obtaining the "baseline" data. It was felt that the baseline was the total amount of sewage collected from both gray and black water sources that would <u>normally</u> be produced during an average day. It was expected that tank flushings and constant running galley eductors were not normal everyday occurrences, and these were secured to enable the observer to obtain the baseline data.

After the data was analyzed, it became apparent that the baseline assumptions were not entirely true. Observations revealed that, more times than not, the galley eductors were not secured after use. Investigations also revealed that it was common practice to leave the eductors running on other ships that were also visited but not reported on. It can be assumed that baseline information should include the high volumes produced by these eductors.

Tank flushings were also not considered as inclusions to baseline volumes. But, as with the galley eductors, it was observed that these flushing systems were activated and were, for one reason or another, sometimes forgotten and remained running for long periods of time before they were discovered.

Based on the above observations, it is realistic to say that the data that was obtained, and reported as "baseline" is lower than the actual because of the controls introduced. The "Normal Daily Volume" column may be more representative of the actual volumes expected to be produced by Navy ships.

The data obtained reveals that there are a number of variables that should be considered when determining the generation rates for CHT ships. From Table 1, it can be seen that constant flushing of urinals has an effect on the generated rates. What is also revealed is that the amount of flushing volume, regulated verses non-regulated, set by each ship affects the generation rates. An example is the BLANDY and the BYRD. Both were on constant flush, but the BYRD's urinals were regulated while the BLANDY's were not.

Other variables that may play a part in the high generation rates are the ships' laundry usage practices, air conditioners piped into the collection drains, and garbage grinder eductor usage practices. Each separate, or all together, has a significant effect on the sewage generation rates.

Data on the water generated when the riser flushing lines were left open could not be collected because of the way the monitoring devices were installed. This volume, when introduced into the pier side collection system, contributes to the "unknown generation rate" that is realized at the shore pumping stations. Also not included are the volumes entering the CHT tank as the pump is pumping. For a pump room discharging about 10,000 gallons per day (a typical DD), the volume not measured is about 2%. The volumes measured and presented in the ship reports have not been corrected. Figure 3 provides a graph to convert the measured volumes to an estimate of the actual pump volumes. The correction graph is calculated using a 400 gpm pumping rate and assumes a constant inflow rate to the CHT tank.

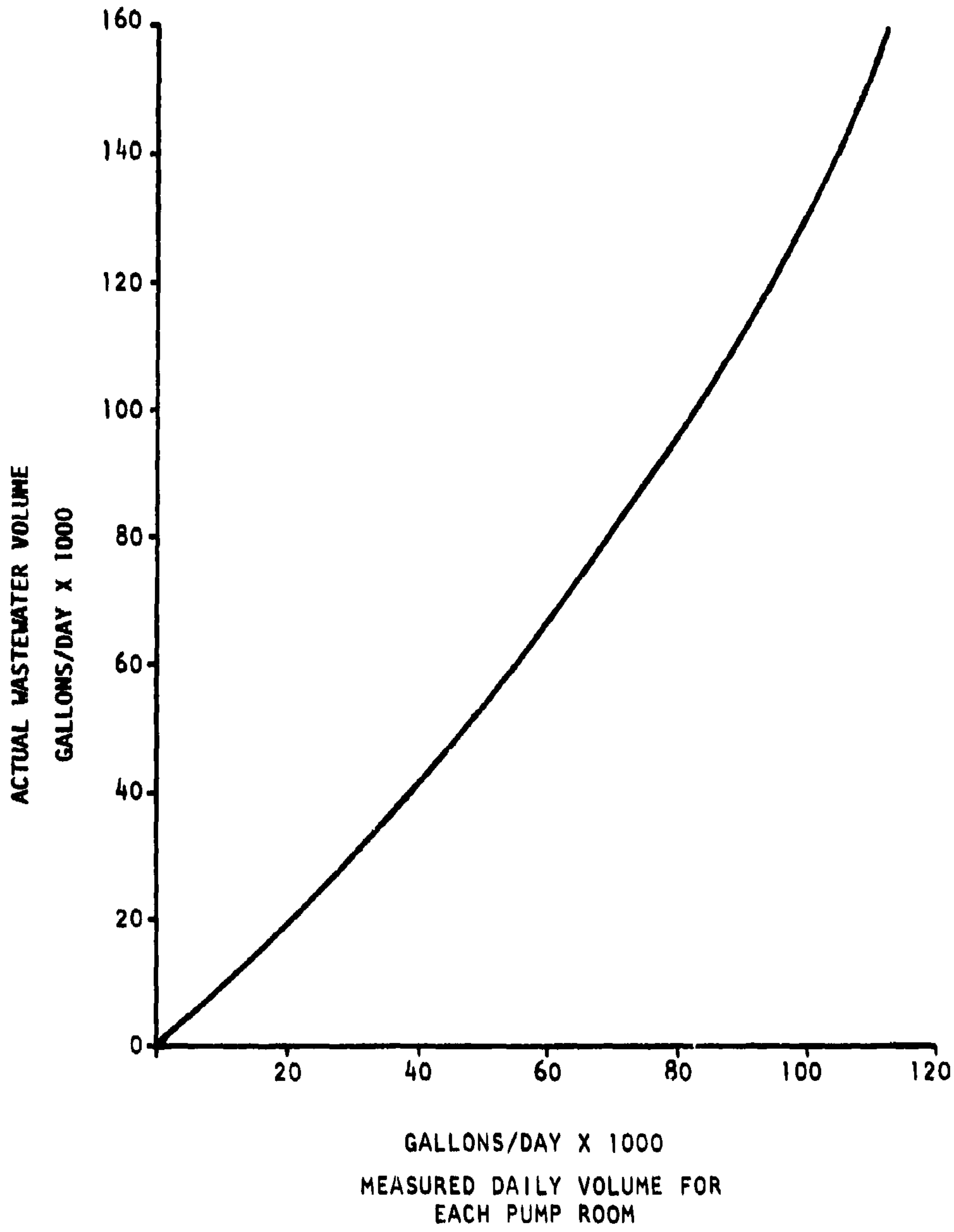


FIGURE 3. Correction Graph for Wastewater Volume

3. SHIP ACTIVATION

Close liason was developed with the COMNAVSURFLANT maintenance section to obtain a list of candidate ships. The selected ships were boarded, inspected, and, if possible, activated. Some ships visited could not be activated because of various mechanical or design problems. The nine ships reported on were all activated by PA Engineering personnel prior to collecting sewage generation data.

3.1 Single Ship Activation Process

The process of activation followed the same pattern in all respects throughout the activations. The ships were identified and notified of the up coming system activations. PA Engineering personnel then boarded the ships and briefed the personnel who were responsible for the CHT system on the objectives of the activation. In addition, a CHT training movie was shown to familiarize the crew on the components of the system and the proper operation of the system.

The system was traced and checked for proper installation. The valves and piping were checked for completeness and workability. The controllers, pumps, and level sensors were checked for proper installation. When the preliminary checks were completed and determined to be satisfactory, salt water was introduced into the tank through the flushing system to see if the level sensors worked properly and to see if the pump controllers worked as designed. It was during this phase that most of the level sensor failures were observed, which effectively put the CHT system out of operation. The problems encountered with the level sensors will be discussed later in this report.

If a successful salt water run was accomplished, the gray water drains were diverted to the CHT tank for collection. This step was done to ensure no raw sewage spills occurred in the event of a system failure. Also, it allowed the ship's force personnel to gain confidence with their system.

When the above tests were satisfactorily completed, the black water drains were diverted to the CHT tank. If pier sewer facilities were available, sewage hose was run from the ship's deck risers to the pier, and the ship then began pumping actively into the pier sewers. If no sewer facilities were available, the ship was diverted to pump overboard. Sewage generation data was then collected using the methods discussed in the previous chapter.

After the systems had been activated and were pumping to the shore facilities, it was necessary to find and isolate the high wastewater producers. The event counters were used to indicate if high producers were present. This was determined by the number of firings per time period. The high producers were traced and cut out of the system by either securing them or diverting them over the side. Readings again were taken to see what effect these practices had on the overall generation rates. The high producers were then listed and their effects were noted.

A field report was produced at the completion of each activation. This report consisted of the following sections:

1. Technical Data--gives technical information about the system. Included is the ship type, type of system, certification status, operating status, date and yard of installation, crew size, and tank size.
2. Test Preparations--what repairs and other preparation were necessary prior to conducting the tests.
3. System Repairs--lists necessary repairs.
4. Operating Summary--peculiarities of the system.
5. Data of the System--tables and figures listing the various tests performed and the data collected.
6. Conclusions-specific conclusions derived from the tests conducted.
7. Recommendations--specific recommendations for each system.

The intended use of the report was to provide the ships with a tool that gives a concise description and operating characteristics of their individual system. In the report, they can find generation rates, transit holding times, and any operating peculiarities that exist within their particular system.

3.2 Nested Ship Evaluation

To complete the objective of determining the effects of combined sewage flows of a nest of ships, it was necessary to develop a nest. Also, the nest provided a testing platform to evaluate the procedures necessary to hook up a nest for sewage transfer.

The VULCAN and RECOVERY were chosen to make up the nest. Both ships had been earlier activated by PA Engineering personnel. The use of these ships was not ideal for the test procedures because a true combined pump through flow could not be obtained, but considerable useful information was gathered.

This nest is not representative of a nest that occurs between ships of similar ship types (i.e.--DD and DDG, DD and FF, etc.) but it is representative of ships being berthed alongside ships of dissimilar ship types. Tests for similar ship types were not conducted because of the inability to schedule this type of nest with certified CHT ships. Details of the nest procedures and findings are in report 10 of Appendix B.

Since the VULCAN collected the RECOVERY's wastewater before transferring it to the pier sewers, there was not a true combined flow into the pier. Earlier tests did show that the piers could easily handle the VULCAN's high volumes of wastewater, so there is no reason to expect that the piers could not accept a combined flow off a nest of ships in a true pump through configuration.

The CHT nesting procedures developed in an earlier project and contained in NSTM Chapter 593 were used and are still a good guideline to be used in a nesting situation. The movement of sewage hose from the shore side to the outboard ship is effectively completed by using ship's force personnel to move the lengths of sewage hose. This method is quicker for this type of ship than any other methods tried.

3.3 Analysis

The CHT system on board the ships visited is considered by ship's force personnel as a low priority system compared to others. Therefore, it is imperative that the operators are properly trained and motivated to put this type system into operation and to use it on a routine basis.

When the CHT systems were activated, ship's force personnel were used in the immediate activation process, the trouble shooting, repairs, and for the data collection. Invaluable "hands on" training was given to the operators.

The nesting evaluation demonstrated the proper methods of hook up. Even though a combined flow through value could not be obtained because of limited pump discharge head, it was possible to demonstrate that the VULCAN can accept inflow from ships outboard, and effectively transfer the sewage to the pier collection facilities.

4. HARDWARE

During the initial activation and the subsequent data collection periods, a number of hardware difficulties were encountered. This chapter identifies and explains some of the problems. Additional discussions on individual ship repairs are contained in the respective ship reports in the Appendix of this report.

4.1 Level Sensors

The major hardware difficulty encountered was with the mercury float level sensors. On seven of the eight ships reported, one or more level sensors failed during the initial start-up or shortly after when the systems were put into operation. The failures were mostly the result of the electrical grounds appearing in the level sensor wiring. It seemed that the rubber covering on the wire bundles rotted and cracked inside the tank, allowing the fluid in the tank to ground out the wires. The majority of the level sensors that failed were either at the 30% level or the 10% level.

On the PAPAGO, the 30% level sensor failed and indicated to the pump controller a constantly closed 30% level sensor. The result was whenever the level was above the 10% level, the pump would run. Because of the size of the PAPAGO, the ship rolled excessively. The rolling caused the fluid in the tank to slosh around and bounced the 10% level sensor. The resulting number of short firings eventually burned out the #1 pump control relay and later fused the pump securing relay (#5CR relay).

On the PORTLAND, the 10% level sensor failed and indicated to the controller that there was more than 10% in the tank when, in fact, the tank was dry. A pump running constantly and trying to pump a dry tank was the result, causing the pump to overheat.

A level sensor failure can result in severe damage to the system if the problem is not detected rapidly. The possibility of a rapid detection occurring is very small because the system is designed to run automatically with little supervision. Except when checked by a watch stander, the system runs unmonitored. A more durable level sensor is necessary for this system. The reliability of the system has been reduced because of the numerous level sensor failures.

4.2 System Status Lights

Throughout this testing period, the CHT system controller was often found to be shut off for a number of reasons. The securing of the controller resulted in piping backup and flooding in some low spaces. Since this system runs automatically with little supervision, a status light on the panel would aid the roving watch in determining the condition of the controller. Figure 4 shows the control panel face without indicator lights.

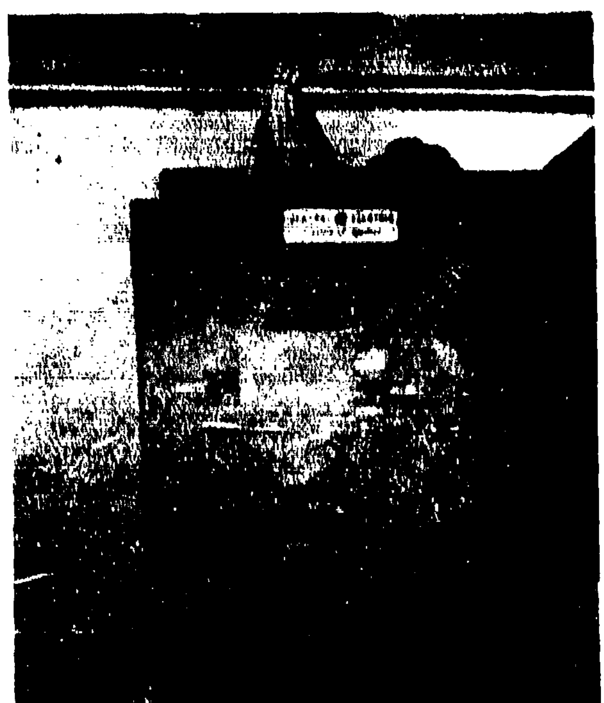


FIGURE 4. Control Panel

The controllers of this system are protected by low voltage protection (LVP) devices that secure the power to the controller if there is a power drop or loss. This device must be reset manually when full power is restored. Unless the pumps are actually running, there is no way for the roving watch to determine if the controller is on other than physically pushing the "Start" button and listening for a quiet click in the controller relays. The addition of status lights will make for safer operation of CHT systems. These lights should include the panel "OFF/ON" status and the pump mode selector switch settings of the motor controllers.

4.3 Exterior Tank Level Indicator

When performing work on the CHT tank, it is difficult to determine the level inside the tank. The only rough indicators at present are the electric level sensors. As discussed earlier, the failure rate of the level sensors presents some concern for using this method of determining the tank level. In addition, depending on the installation, there is no sure way of telling what is the actual level when the level sensor closes. It is imperative that the operator know the exact level of the tank before any accesses are opened. For example, on the majority of the ships visited, the transfer pump loses suction on the tank when the level of the tank is still above the 10% level sensor access. Unless the operator is aware of this, removal of the 10% level sensor for repair will cause an unpleasant situation.

4.4 DC Controllers

Two ships that were activated were equipped with DC controllers instead of AC controllers. Both the PAPAGO and RECOVERY have DC current as their primary power sources. The PAPAGO uses 230 volts DC in the controller, while the RECOVERY uses 115 volts DC. While observing the relay switching action on both ships, considerable arcing was observed. It was more pronounced on the PAPAGO than on the RECOVERY. In addition, investigations revealed that the contacts on the PAPAGO were showing excessive amounts of pitting, while the RECOVERY's were not. The failure on the PAPAGO of the two relays (#1 Motor Controller and #5CR control relay) can be attributed to the higher voltage which burned the contacts off the motor control relays and completely fused the control relay. It may be beneficial to operate the DC controller circuits by using lower voltages in these systems.

Another DC control relay discrepancy noted was the tendency of the screws attaching the movable contact plate to the relay throw arm to work loose and fall out. This was observed on the RECOVERY on two occasions. As a result, the duty pump continued to run past the 10% mark. Lock washers were installed with the set screws, but they were not sufficient. A more reliable method of securing these screws is necessary.

5. SOFTWARE

As with the hardware difficulties encountered, a number of software problems were encountered during this project. This chapter identifies and explains these problems.

5.1 Repair Parts Support

Failures of various components of the CHT system have been previously discussed. Obtaining replacements for the failed components became an involved process. The reason for the difficulty in obtaining the replacements was investigated and a fundamental repair parts support problem was discovered. The majority of the ships did not have the necessary Allowance Parts list (APL) pages for their Consolidated Shipboard Allowance Lists (COSAL). The APL pages that the ships had were the preliminary pages that were provided to them when the CHT systems were installed. These APL's did not have the necessary information needed to order the repair parts. The COSAL's had not been up-dated, and the required complete APL pages had not been requested. Without the correct APL pages, the operators were unable to obtain the necessary repair parts through the Navy Supply System. Since there was no demand detected by the Supply System, no repair parts were readily available. Extensive delays were encountered when the parts were finally ordered.

The appropriate APL pages were requested by the individual ships, but they have not been received as of yet. A delay in the distribution of the APL's has been acknowledged by the Supply Center in Mechanicsburg and is presently being corrected.

5.2 The Sewage Disposal Operating Sequence System. (SDOSS)

SDOSS manuals have been provided to the majority of the ships visited. Those who do not have them at this time are being provided with them in the near future. The manuals are of some use to the operators, but there are difficulties with the layout of the manuals. Figure 5 is provided as an example. This page was taken from the SDOSS manual for the PORTLAND. This page illustrates a number of decks and spaces which the CHT piping system runs through. To an individual unfamiliar with this type of document, this diagram is difficult to follow and to understand. The personnel responsible for the CHT system most likely have never been exposed to this type of documentation system. An informal survey was conducted, and it revealed that the SDOSS was not being used because of the confusion that it produced. The format of the manuals should be modified to make it easier for the users to understand the information provided.

5.3 Maintenance

The maintenance held on the CHT system is less than adequate for systems that have never been used. Some maintenance is being accomplished on the major components such as pumps and diverter valves. The degree of maintenance accomplished differs from ship to ship. There is a Preventive Maintenance System (PMS) package developed for the CHT system. See Table 2 for the ships that have the PMS installed.

Maintenance was not being performed on the level sensors, aeration systems, and the collection tanks. This was apparent by the number of level sensors that were found to be faulty, the number of air silencers that were rusted out, and the number of tanks that had septic sewage in them, even though the systems were secured and layed-up. Table 2 is provided as a summary on the corrective maintenance required of each ship visited. A more detailed discussion on the individual maintenance required for each ship can be found in the ship reports in Appendix B.

It appears that there is a correlation between the degree of difficulty encountered when attempting to activate a system and the length of time between installation and activation. Maintenance practices also play a large part in determining system activation effort. (i.e.--the less maintenance performed, the more difficult the activation).

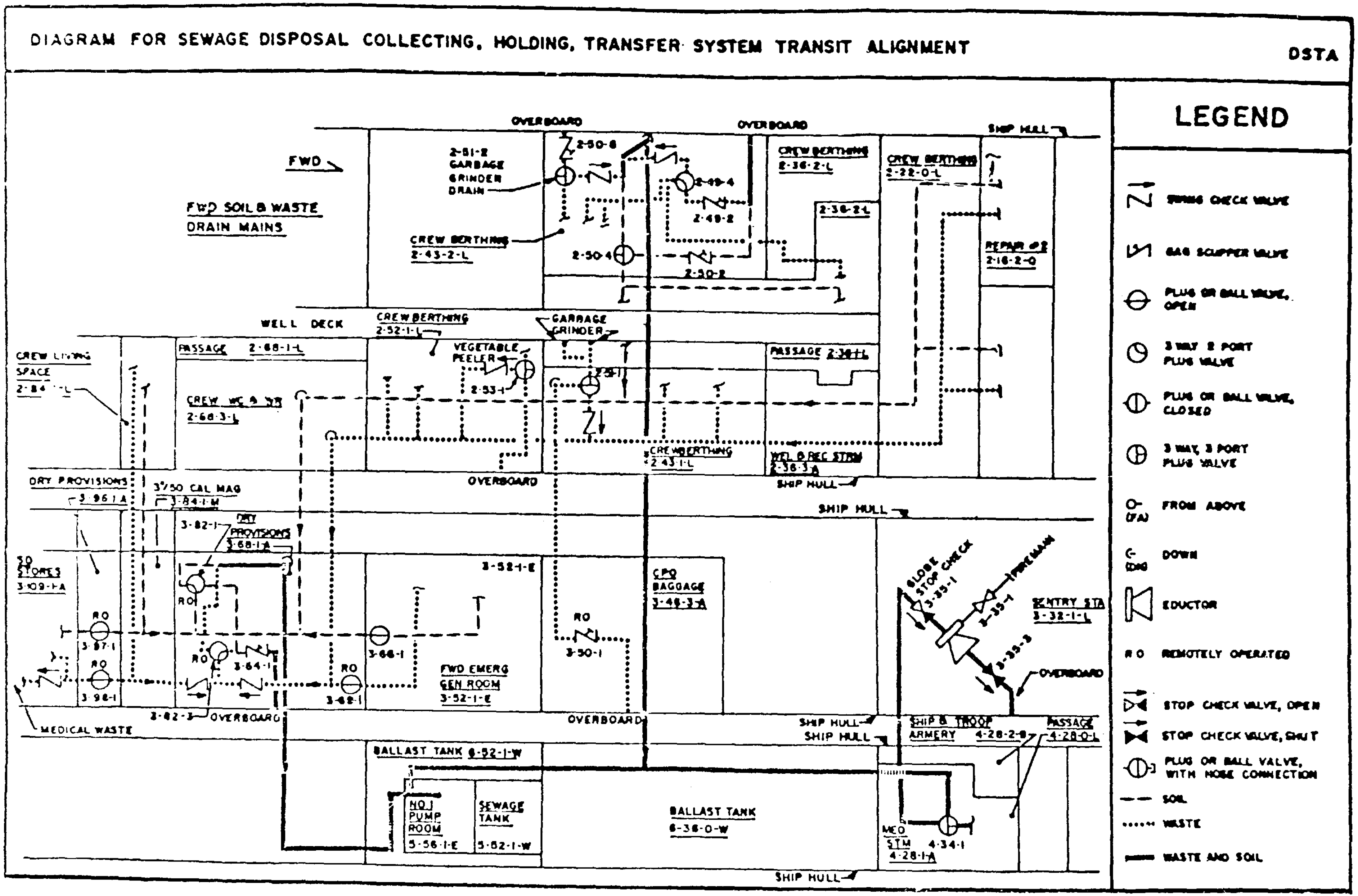


FIGURE 5. SDOSS Diagram

TABLE 2
SYSTEM REPAIRS TABLE

SHIP	VALVES AND PIPING	ELECTRICAL	LEVEL SENSORS	PUMPS	ALARMS	SYSTEM DOCUMENTATION	DATE SYSTEM INSTALLED
BYRD	FWD inflow stop valves frozen. Valve handles broken.	AFT motor controller relay(IM) corroded. Sump pumps inop.	AFT 10% & 30% level sensors w/broken wires. 10% level sensor installed too low.	Bad bearing #2 forward pump motor.	Not reset	SDOSS aboard PMS aboard	1975
BLANDY	5 isolation valves missing. 7 valves inaccessible. Valve maintenance marginal.	FWD sump pump inoperative.	10% L.S. in both tanks inop. with faulty switches. 30% & 60% required MOD kits.	No discrepancies.	No discrepancies	SDOSS aboard PMS not aboard	7/76
VULCAN	Incorrect markings. All diverter valves in locked spaces.	110 fuse boxes in locked space. Communitor light missing forward.	10% forward mounted too low.	AFT communitor blades jammed.	No discrepancies	SDOSS not aboard PMS aboard	2/76
FAIRFAX COUNTY	No discrepancies	No discrepancies	No discrepancies	No discrepancies	No discrepancies	SDOSS aboard PMS not aboard	2/78
BEARY	No discrepancies	No discrepancies	10% FWD mounted too low.	No discrepancies.	No discrepancies	SDOSS not aborad PMS aboard	1/76
PORTLAND	AFT soil diverter valve not installed. Remote operating gear frozen. Air blower silencers rusted.	New cable run for FWD 10% L.S.	10% L.S. grounded w/broken wires.	Bearing AFT communitor bad.	No discrepancies	SDOSS aboard PMS aboard	12/75

TABLE 2
SYSTEM REPAIRS TABLE - Continued

SHIP	VALVES AND PIPING	ELECTRICAL	LEVEL SENSORS	PUMPS	ALARMS	SYSTEM DOCUMENTATION	DATE SYSTEM INSTALLED
PAPAGO	Incorrect markings. Soil diverter valve installed backwards.	#1M motor controller contacts burned off. #5CR relay fused.	30% L.S. failed with ground in cable.	No discrepancies.	No discrepancies.	SDOSS aboard PMS aboard	9/77
SAGINAW	AFT deckriser damaged. FWD sump pump does not take suction. Air blower silencers rusted.	No discrepancies.	60% L.S. forward failed. Bobbin missing.	No discrepancies.	Alarm remotes in pump rms. inoperable.	SDOSS aboard PMS aboard	1/77
RECOVERY	No discrepancies.	#4CR relay set screws fell out.	No discrepancies.	No discrepancies.	No discrepancies.	SDOSS not aboard PMS not aboard	3/78

5.4 Training

While activating the CHT systems on the test ships, it became very apparent that the majority of the operators did not know how to operate the system correctly. There is a great deal of concern about the "unknowns" of the system. Ship's captains have been directed to activate and use the system, but without direct instructional aid, they are reluctant to do so.

The ships visited have sent personnel to the Navy training schools for CHT operation instruction, but the trainees reported that the material they received was directed more towards maintenance than to the operation of the system. The majority of the operators were required to "self learn" the system and because of inexperience with the system, spills and failures have occurred. As not to cause any more problems, the systems were layed up until the time the ships could receive the necessary aid to learn how to operate them.

At the beginning of each ship visit, concern and skepticism had to be overcome. Once that had been accomplished, the commands and operators took more interest in the system. For CHT's to be universally accepted and operated on a continuous basis, more attention needs to be given to the concerns of the operators. This activation project demonstrates that for a system of this type, when there is support provided by external sources, more interest is taken by the operators.

NSTM Chapter 593 is available to the operator, but the majority of those asked did not know that it existed. Again, this relates to the general ignorance about CHT system. Another difficulty is that the technical manuals for the systems have not been received by some of the ships.

6. CONCLUSIONS

The primary reason the sewage generation analysis was initiated was to obtain an insight to the actual generation rates of U.S. Navy ships. Secondary to the main task was the activation of the nine ships in the Norfolk area. Throughout the project a number of conclusions about the operational status of the CHT system were developed. The following conclusions were developed while working with the ships and are presented to give some insight on how the system is operating and progressing to meet the 1981 activation goal.

6.1 Wastewater Production

As discussed in an earlier chapter, the data that was collected and summarized in Table 1 shows that there is definitely a higher sewage generation rate than was anticipated. The per capita daily averages presented in Table 1 show considerable differences between ships. This trend is to be expected for all CHT systems. Of the eight ships reported on, only two were determined to be within the 60 gpcd standard for sewage generation during the normal everyday configuration before minor controls were accomplished. The remaining ships were anywhere from 1.5 to 7.2 times the design standard. The fleet daily average generation rate can be expected to be between 144 and 157 gpcd. This is 2.4 to 2.6 times the original 60 gpcd design estimates.

From the data shown, the 60 gpcd standard appears unrealistic and cannot be met with ships using their present day practices. Guidelines are necessary to help control the amount of constant flushing required to combat scale formation in the soil lines, and to encourage the practice of securing galley drain eductors after use. These sources contribute most of the excessive wastewater volumes.

Extensive "hands off" monitoring of wastewater volumes from at least 30 ships with CHT systems is necessary to confirm the data from the relatively small sample presented.

Wastewater volumes can be monitored by either:

- -Extensive data collection from at least 30 ships during a 60-90 day period.
- -Each ship maintaining a log of pumped volumes calculated from pump cycle counters installed in each control panel. (Previously recommended to provide operator control information).
- -Measurements from shore side installed volume meters on each pier riser.
- -Rough estimates from PWC supplied wet well volume measurements.

On the NEWPORT class LST's, the laundry is a large producer of gray water. Operators exhibit no apparent concern for the conservation of fresh water use while in port. Therefore, the laundry is used in such a manner that small individual loads are done instead of larger, more efficient water usage loads. The FAIRFAX COUNTY produces 8 times more wastewater forward with the laundry collected by the CHT tank than with the laundry diverted over the side. The SAGINAW produced 2.4 times more than with the laundry diverted.

The calculation of the transit times for the ships monitored indicated that none of the ships could totally meet the 12 hour holding time requirement while transiting. The constant flushing of urinals appears to be the major cause of this problem. Other typical causes were the collection of the air conditioner drains by the CHT system (VULCAN), and insufficient tank size to handle the load (PORTLAND and BEARY).

6.2 Hardware

Throughout the performance of this project, the completion of the objectives was hindered by the previously outlined hardware discrepancies. These discrepancies are a detriment to the successful crew acceptance and operation of the CHT system.

The level sensor's rubber covering appears inadequate as the corrosive content of the tank and abrasive action against the tank wall causes severe deterioration. This leaves the wiring susceptible to grounding.

A tank level indicator, regardless of the design, is needed because of the inability of the operator to determine the level of the fluid within the tank.

Indicator lights are needed to show the status of the system, particularly if it is "ON" or "OFF".

Various check valves leak-by allowing raw sewage into the aeration systems, and in the case of the PAPAGO, allowing sea water to seep back into the holding tank from the discharge lines.

The above noted hardware discrepancies make it difficult to operate and maintain this system with confidence.

6.3 Software

The software for the CHT system is failing to provide the support intended. At the present time, there appears to be a large degree of ignorance about the system, and the introduction of the CHT system is being met with skepticism and concern. More emphasis is required in training personnel in the operation of the system. The training provided now at the formal schools is insufficient to meet the needs of the operators and to ensure that the system is operated with confidence. At present, the curriculum deals mainly with maintenance rather than with operational techniques.

The user guides (SDOSS) are not providing satisfactory guidelines and information for the operation of the CHT system. The SDOSS manuals are slow in being developed and implemented and there appears to be little instruction given on how to use the manuals. In addition, the diagrams are difficult to follow.

The technical manuals are not always provided to the ships when their systems are installed. Without these manuals, troubleshooting and maintenance cannot be performed.

The repair parts support does not provide the necessary parts when they are required and the necessary APL pages are not held by the CHT ships. These pages are available at NSC Mechanicsburg, but the distribution has been slow.

The PMS is adequate for the pumps and valves, but changes are required in the frequency of tank flushings and level sensor checks.

To make the operation of the CHT system more acceptable, the problems of the software support have to be addressed. Without the proper support, the shipboard skepticism and concern over CHT operation will remain.

7. RECOMMENDATIONS

Throughout the CHT field evaluations conducted in the Norfolk area, PA Engineering personnel worked closely with the users of the CHT system aboard each ship visited. In addition, close liason was held with the maintenance personnel at COMNAVSURFLANT. A considerable amount of information was gained during these studies. The individual field reports are very detailed on the findings of each ship and give an insight as to the average condition of typical CHT systems. Individual recommendations were made for each ship to upgrade its system and also to upgrade the overall CHT program. The following sections contain recommendations that may enhance the operation of the CHT system and aid in the acceptance of the entire program.

7.1 Wastewater Reduction

The data collected shows the sewage generation rate is excessive for most ships. The major reoccurring causes were determined to be the high urinal flushing volumes necessary to control the scale formation in the soil drains and the constant running of the galley eductors and the tank flushing systems.

The following recommendations may reduce the daily load to the "Controlled Average" of 108 to 99 gpcd, shown in Table 1 of Chapter 2.

1. Install solenoid valves on all garbage grinders and other salt water eductors to automatically secure them when not in use.
2. Insure that all tank flushing valves are labeled "X" and regularly checked.

The daily ship per capita load may be reduced to near or below the design average of 60 gpcd if the following additional recommendations are accomplished.

3. Successfully solve the scale buildup problem in urinal drain lines and provide guidelines for constant urinal flushing.

4. Accomplish SHIPALT's to remove any salt water cooling drains or other non-sanitary high volume drains from the CHT system.

5. Reduce wasteful laundry operation practices.

6. Divert gray water overboard where possible for extreme situations.

Before concerning shipboard personnel with limiting the quantity of wastewater produced, the overall cost and savings must be determined. More important, if the ships become required to monitor sewage volumes and control saltwater use too soon, there will be extensive fleet resistance to such a program which can hinder meeting the 1981 full operational goal. When the use of CHT systems becomes routine the operators will more easily accept and understand the need for a program to control excessive wastewater production. Until then, the actual cost of fleet sewage processing should be closely monitored and the extent of excessive wastewater production watched as more ship CHT systems get activated.

7.2 Hardware and Operations

The detailed ship reports contain several recommendations to help in CHT system operation and should be considered by NAVSEC for future system designs or alterations. Some 15 ships with CHT systems have been activated by PA Engineering during the past year and a half in Norfolk and San Diego, and this work has confirmed the need for these recommendations.

1. The pump control panel needs an indicator light to show if the control relays have been reset. This light will give the operator or the roving watch a simple indication that the start button has been reset. Typically, after a power failure the controller is not reset and the watch is not aware that the control relays are de-activated. A lamp set into the panel door and wired between terminals 9 and 8 would indicate when the control relays have power. Figure 6 shows a wiring schematic of this installation.

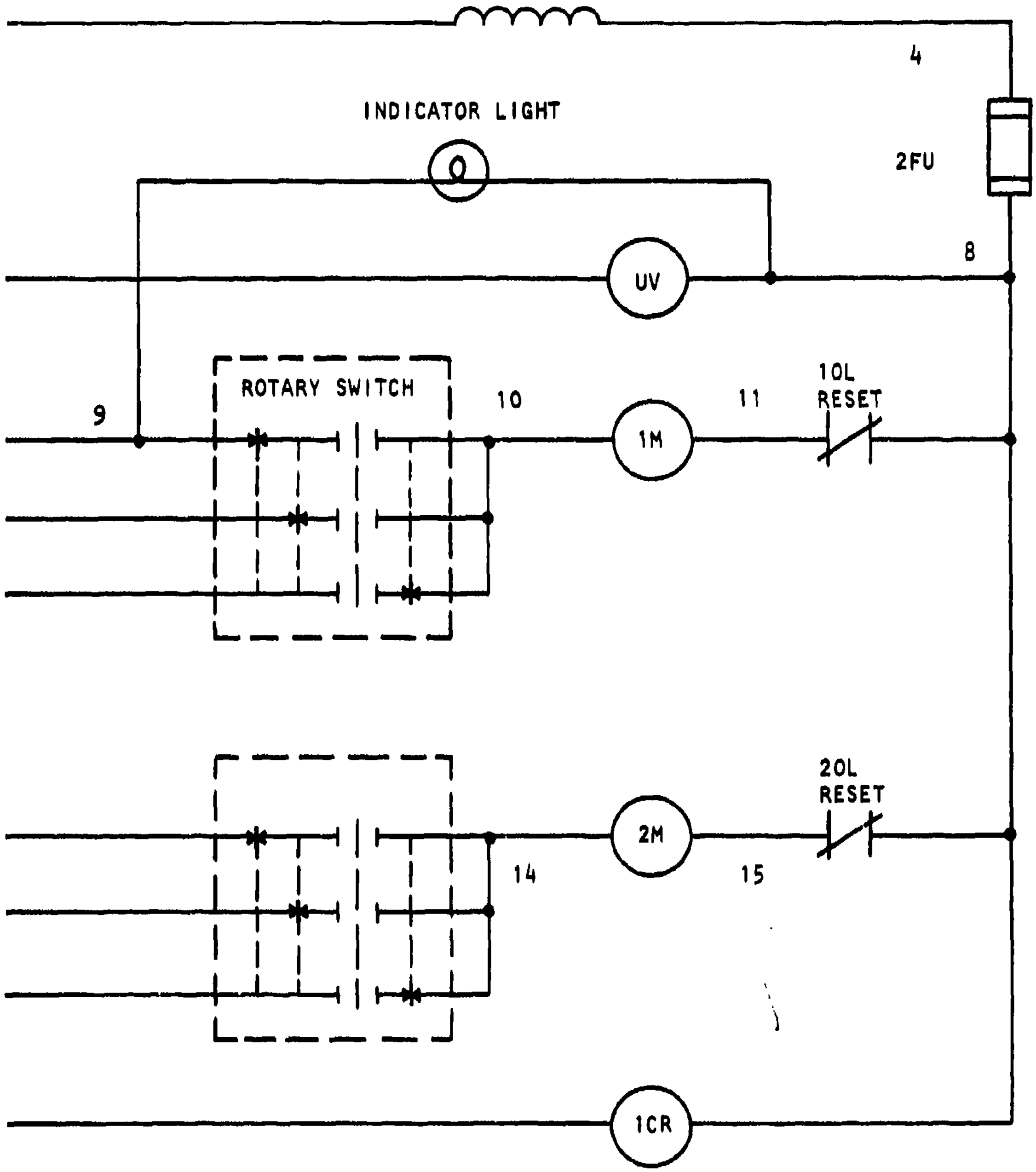


FIGURE 6. Wiring Schematic for Indicator Light

2. Other indicator lamps for the controller are needed to indicate if the pumps have been switched to the automatic position and to indicate the status of the duty and standby pumps.

3. The controller should be modified to prevent the activation of the standby pump when the 30% level sensor is reactivated by wave action in the tank. In large tanks the majority of pumping cycles is by the two pumps due to the sloshing of waves in the tank.

4. High volumes of wastewater are being generated on some CHT ships. Often this is the result of saltwater valves being left on or problems in the plumbing system. There is no way for the ship to know if the volume of wastewater pumped is excessive. A 120 volt event counter should be set into the control panel door and wired between terminals 10 and 14. This will indicate how many times the duty pump level (30% level) has been reached. By knowing the volume between the 30% and 10% levels the CHT operator will know the volume he has pumped. Figure 7 shows the wiring schematic for the counter installation.

5. For safe operation and maintenance of the CHT tank and pump, it is necessary to know the level inside the tank. In our testing program we have used a portable tube with a fitting screwed into the drain plug of the pump. This gives a good indication of tank level as the liquid rises up the tube to the height of the water inside the tank. This portable tube is useful but impractical for shipboard installation. A removable clear plastic tube could be fitted alongside the tank attached to a petcock drilled into the tank near the suction level of the pumps. The top of the tube would be fixed to another petcock near the top of the tank and a screen at the inlet of the petcock would help keep solids out of the tube. If the tube became discolored or dirty, it would be easily removed and cleaned. This cleaning operation could be quickly and safely done and would be simpler than most CHT maintenance tasks.

6. We have seen several broken pipe handles and cast iron fittings for the valve handles of the isolation ball valves. Another type of handle for these valves should be found.

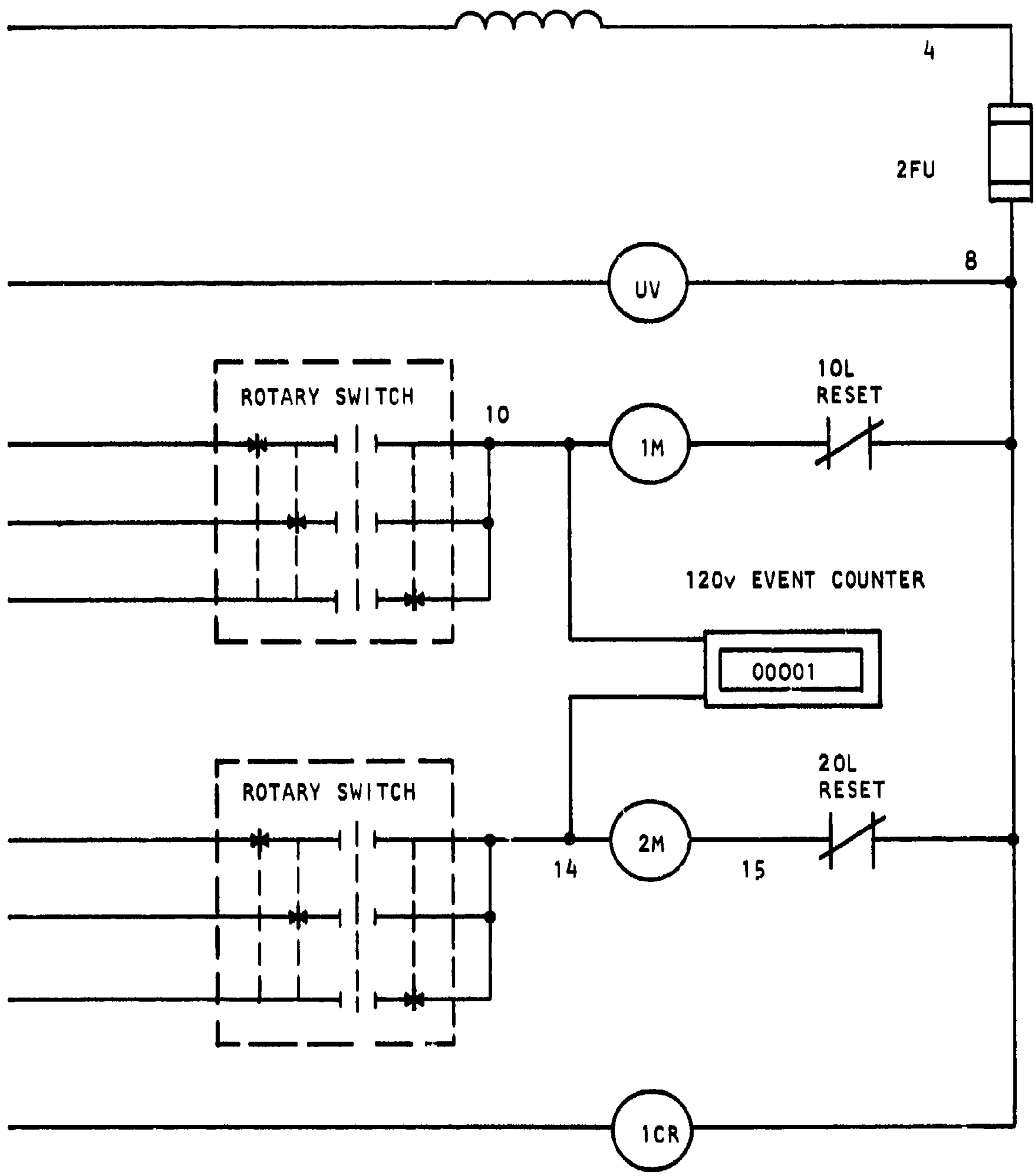


FIGURE 7. Wiring Schematic for Event Counter

7. The "T" handles for the jack screws on the pump check valves should be replaced with a larger round handle. The larger round handle would make it easier to open the check valve for discharge line draining and would eliminate a blunt point that is dangerous when crawling around the piping in cramped pumprooms.

8. Most of the pump control panels contain two voltage cources. A 440 volt power source is provided for the pump motors and control relays through a transformer. A separate 120 volt source is provided for the alarm circuit. This second voltage source is not always obvious to the electrician. A warning sign on the panel door is needed to warn of the two voltage sources.

9. The PMS card that requires the test operation of pumps and high level alarms should be increased from quarterly to at least monthly. The weekly tank flushing for operating CHT tanks should be included as part of the PMS system.

10. We suspect the majority of failures with the mercury level sensors are the results of the failure of the cover insulation of the 4 wire bundle. The cause of the sensor failure should be examined more closely to determine if a more suitable material is available. Because of the unavailibility of replacements, temporary fixes have been made using the spare leads, red and green, of the wire bundle.

11. The silencers for the air blowers are rusting out from water and sewage collecting in them when the CHT system is not in use. Also, water tends to leak-by the air check valve when the tank overflows. A drain is needed in the low point of the silencer to remove the collected water. Such drains were installed in the air system of the USS Saginaw. Additionally, an isolation valve should be installed to prevent sewage passing into the air line when the air is secured. Figure 8 shows a silencer with a drain line on the SAGINAW.

FIGURE 8. Silencer with Drain

12. Some protection should be considered to prevent the pumps from running dry if the low level sensor fails. A running time limiter in the control circuit is one solution. A series backup sensor using the red/green spare switch of the mercury sensors could also provide some additional protection. This problem is of concern because of the dependent design on the low level sensor in the control circuitry and high number of sensor failures we have observed.

PART II

PIER OPERATIONS ASSESSMENT

PIER OPERATIONS ASSESSMENT

1. INTRODUCTION

For the period May through October, 1978, PA Engineering conducted a pier operations assessment of the ship sewage collection systems located in the Norfolk area. The objectives of this project were to provide technical documentation consisting of operations and maintenance support data and recommendations to insure compliance with the Navy's OPNAV Instruction to achieve CHT operational status by 1981. Selected portions of the Naval Amphibious Base, Naval Shipyard, and Naval Station were evaluated for capacity as determined by the as-built drawings provided. Also, necessary procedures were determined to effectively operate the systems under normal conditions and to respond to emergency situations as well.

The following sections of each Naval facility were evaluated:

Naval Amphibious Base - Piers 56 through 59 and Quaywall berths.

Naval Station - Piers 20 through 23.

Naval Shipyard - Drydock 3, 4, and 8.

2. SYSTEM DESCRIPTION

The collection systems described in this report were installed in 1973-1974 to enable each activity to comply with the Federal Water Quality Act of 1972 as specified in DOD Directive 6050.4. They are designed to collect shipboard generated wastewater and convey this material to the local municipal treatment plant. The local facility is operated by the Hampton Roads Sanitation District with headquarters in Virginia Beach, Virginia.

Design of the systems followed those requirements set forth in NAVFAC Design Manual DM-5, April, 1974. The basic layout as determined in this study generally follows the requirements as established, with major exceptions in the areas of capacity, to receive peak flow (as determined by DM-5 methods) from maximum planned berthing arrangements and minimum full pipe flow velocities to prevent deposition of solids. These areas are described in the Conclusions and Recommendations sections of this report.

The three systems investigated incorporate suitable piping materials and connections to facilitate ship to shore sewage transfer. Major sections of pipe run are exposed ductile iron suspended below pier structures. Because of their location, exposed to the weather and with minimum slopes, there is reason to believe that cold weather may affect systems operations by way of the deposition of solids and freezing of pipe contents. This necessitates additional maintenance procedures to insure continuous operation.

2.1 Gravity Sewer System

The gravity sewer systems located at these three facilities provide for ship to shore connection via deck risers and subsequent sewage transfer through sloped portions of sewage conduit. Main lines extend to the pump stations which receive and transfer the sewage into force mains for transport to the municipal treatment plant.

At the Little Creek facility, pier piping extends along one side of each pier and collects material from opposite side collectors by way of lateral sections of pipe. Absent at this facility are cleanout access points along the pier lines. This necessitates the use of the pier risers in certain situations as access points to flush the pier side systems.

At the Naval Station, two separate pier lines run the length of each pier that was studied. Each side of the pier is equipped with a full sewer line running the entire length of the pier. Also, cleanouts are provided for water flushing of the lines as that becomes incorporated as a standard procedure for maintenance purposes. These destroyer and submarine piers consist of multiple connections with a "Y" fitting joined to the main pier line and accessed by two four inch camlock fittings. This requires consideration when a ship is pumping into one side of the collector. Should access to the second camlock riser be required it will be necessary to request ship's personnel to temporarily close the ship deck riser while access is made to the other camlock fitting.

The Norfolk Naval Shipyard system that was investigated consisted of the dry dock facilities, numbers 3, 4, and 8. Drydock 3 is a typical gravity type system as well as dry dock number 4 where sewer main is extended along the interior walls of each dry dock and outfitted with ship to shore connections, clean outs, and vents.

Review of the as-built drawings of the gravity systems at all facilities reveals that full flow velocities are generally less than those stipulated in the DM-5 manual. In the case of the Naval Station, velocities along the pier generally range in the neighborhood of 1.7 to 1.8 fps. The DM-5 minimal requirement is established at 2.5 feet per second. This situation is not unique to the Naval Station and also occurs in the gravity systems which were studied at Little Creek and Portsmouth. The net result is the need for increased inspection for the settling of solids with the potential for blockage as the system is used. Routine inspections should be conducted by lifting the manhole covers at each of the facilities and observing for these characteristics.

The sewage from shipboard is transfered to existing pump stations which have wet wells and, typically, main duty pump and stand-by pumps, to be operated when flows exceed the capability of the main pump. These stations are routinely inspected on a daily basis at the Naval Station and this procedure should be carried over to Portsmouth and Little Creek.

2.2 Pressure System

Drydock 8 at the Portsmouth shipyard is fitted with a force main pressurized by salt water directed through a flow rate controller. All ship to shore connections are isolated by gate and check valves. Since slope is of no consideration in this type of system there should be no problems of solids buildup and minimal freeze problems if the saltwater line is activated regularly. Care should be exercised, however, to control the volumes of salt water introduced ultimately to the municipal treatment plant.

3. DESIGN EVALUATION

The method used to analyze the shore side collection systems consisted of obtaining the available as-built drawings of each of the systems. Supplemental to reviewing these drawings, visits to each of the facilities were conducted and included a walk-through of each system.

The drawings were used to determine the lengths of pipe installed, the slope at which they were installed, and the diameters of each section. These values were then applied to the Manning formula nomograph to determine full flow velocities and discharge rates.

3.1 Full Flow Velocity And Capacity

At the Little Creek facility, velocities at full flow appeared to be less than the DM-5 minimum requirement of 2.5 fps. A review of the accepted design calculations showed that these designed velocities pertained to pipes of larger diameter. This results in the system full flow velocities being lower than required to prevent the settling of solids in the line when the system is in use.

The capacity of each pipe run is sufficient to handle the volume of sewage expected from the estimated berthing arrangement of each facility. However, when applying DM-5 peak flow calculations to these berthing arrangements it appears that the flow rate capability of these sewer systems does not meet the peak flow requirement as calculated. This calculation is based on the maximum single pump rate capability of the largest ship at berth added to the average flow rate expected from the remaining ships at berth. This formula is deficient since experience with CHT systems shows that pumping is intermittent and does not produce outflow on a continuous basis. It is unlikely that all pump systems on all ships at berth will be activated simultaneously or for a sufficient duration so the capacity of the sewer systems should not be exceeded.

3.2 Berthing Limitations

Berthing arrangements at these facilities are decided on the basis of power availability and personal preference. Since the volumetric capacity of the sewer lines at each facility is sufficient to handle large volumes of sewage and sewage pumping is on an intermittent basis only, these shore side collection systems should be able to handle berthing arrangements based on the above criteria. All pump stations are equipped with duty and standby pumps which will allow for maximum anticipated flows.

The wastewater production data presented in DM-5 estimates a per capita discharge rate at 60 gpd. Based on the ship side study presented previously in this report, this number is lower than actual wastewater production. As shown in Table 1 of Part 1 normal daily generation rates average 144 gpd per man. This is more than two times the estimated value given in DM-5. A prime factor for these high rates in the ship activation study proved to be the operation of high volume sources such as constant flush urinals and garbage grinder eductors in continuous operation. To effectively match up shore side capabilities to ship side production, it will be necessary to determine more reliable estimates of this generation rate. Also, in the case of amphibious craft it must be considered whether ship's complement at pier side will include troops aboard.

4. OPERATIONS AND MAINTENANCE

To insure that the shore side collections system is a dependable utility, it is necessary to provide regular maintenance and service procedures. These activities must include a systematic program of cleaning, inspection, and repair that reduces breakdown to a minimum. The recommended policy to establish this preventive maintenance plan is as follows:

1. Execute a basic plan of routine maintenance.
2. Immediately investigate all complaints and correct faulty conditions.
3. Continue routine inspection for any physical damage and perform necessary repairs.

Personnel requirements to accomplish an efficient sewer maintenance program are available from the local public works department of each activity. These include supervisory personnel as well as maintenance and emergency crews . The maintenance crews should also include individuals capable of inspecting the system for damage and potential problems. Also, they should be fully equipped to perform routine cleaning assignments. More frequent attention should be given to those sewers known to be sources of trouble. Emergency crews should be headed by a foreman capable of responding to emergency situations and should be equipped with the necessary equipment such as safety harnesses, blowers for artificial ventilation, and repair materials such as pipe patches and pipe plugs. Also, safety considerations require the use of rubber boots, gloves, and safety helmets (see Figure 9).

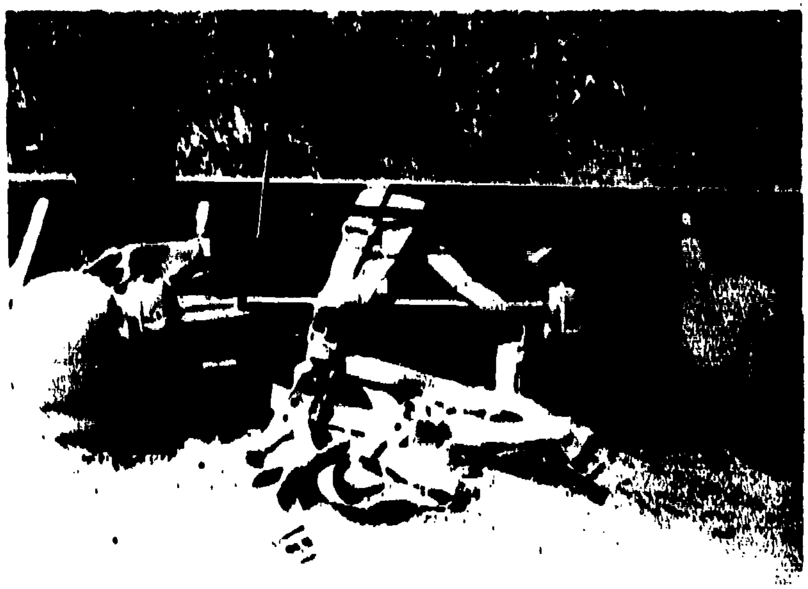


FIGURE 9. Maintenance Equipment

4.1 Normal Maintenance

Preventive sewer maintenance should include a systematic cleaning of the entire system. This includes the removal of blockages, and the planned inspection of known trouble areas. The frequency of such cleaning procedures should be determined as operational experience is gained. More frequent cleaning should be instituted where necessary. This is important to reduce the blockages brought about by the lower velocities of this system. Special considerations for these facilities which promote more frequent cleaning schedules are:

1. The sewer is laid at a relatively flat grade.
2. The intermittent flow of ships' waste.
3. The use of shipboard garbage grinders.

Inspection of the sewer system is easily performed by lifting a manhole cover, looking into the manhole and establishing that there is adequate flow. This activity does not constitute an entire inspection program, however it can provide early warning of problems and should supplement an overall preventive maintenance program.

Blockages most usually occur in the manholes. These can be caused by grease, sand, buckets, sticks, rags, or breaks in the sewer line. Hydraulic stoppages are often found in long sewer line runs installed with flat grades. Barriers to the incoming sewer stream can cause the buildup of grease, the deposition of solids, and the eventual physical pluging of the line. When a blockage is reported, manholes should be inspected until the first dry downstream manhole is reached. It can be assumed, then, that the blockage is between the first dry downstream manhole and the next manhole upstream. It is possible, then, to insert a rod upstream from the dry manhole affording the advantage of a clear manhole from which to work. Complete blockages caused by sand, grease, or debris may be opened and removed by flexible steel rods. Subsequently, hydraulically operated cleaning devices can be used. Some activities, such as the Naval Shipyard, use contracted sewer repair and maintenance services.

4.2 Emergency Procedures

Aside from normal inspection and maintenance procedures, certain conditions may arise whereby there is a large instrusion of sea water into the system by a pipe break on a pier line which is submerged. The emergency procedures to be followed are documented in the individual SOP's following in the Appendix of this report. Basically, they consist of installing pipe plugs of different types and sizes or pipe patches for quick and temporary repairs. Those sections of pipe which are temporarily taken off the line due to such failures may be bypassed by extending longer sections of 4 inch hose from the ship to the next downstream pier riser that is in operation. An alternative to this is to simply lead the 4 inch hose into a working downstream manhole. The pipe plugs shown in the Appendix consist of inflatable ball plugs, inflatable bag plugs, and the screw type disk plug. All plugs are inserted into the sewer line through the manhole and tightened to seal the outer edges of the plug to the inner wall of the sewer pipe. Care should be taken during this operation for the safety of the personnel entering the manhole. These safety procedures are detailed in the individual SOP's in the Maintenance and Safety chapters.

5. CONCLUSIONS

The following are conclusions concerning the operation of pier sewers. These conclusions are the result of work with ship sewage systems using the pier sewers and working with shore side operating personnel. Although they are the result of examining Norfolk area systems, they apply to most other Navy pier sewer installations.

1. The majority of pier piping sections and underground sewer mains have been installed with a relatively flat grade. In most cases, as was mentioned previously, maximum capacity full flow flow rates are less than 2 feet per second.

2. Pier piping evident at all facilities is suspended below pier level and is exposed. This exposed pipe may tend to freeze in cold weather conditions and require additional maintenance.

3. NAVFAC Design Manual (DM-5) presents estimates of wastewater generation which are lower than actual measurements recorded.

4. The peak flow equation given in DM-5 is not realistic to the extent that it does not consider the intermittent pump cycling of CHT systems on board ship. Attempting to match up the capacity of the shore side lines to the peak flow derived from this equation gives the result that the shore side lines are not capable, or at least minimally capable, of handling peak flow. However, experience shows that CHT pumping cycles occur intermittently and for short duration only. It is unrealistic to assume that all ships berthed at a given set of piers will be cycling at exactly the same time, hence, the loads to the shore system will not approach the calculated peak flows.

5. At this time, piers are not isolated by gate valves. This situation does not preclude the effective maintenance of individual piers to be taken off line. This may be accomplished by installing suitable pipe plugs to isolate these piers and will be more cost effective than installing individual gate valves at the terminus of each pier. Also, multiple collectors need not be isolated by check valves as efficient procedures by ship side personnel, namely closing deck risers temporarily while shore side personnel must access multiple pier risers, precludes the need for pier riser valves.

6. Standard acceptable sewer maintenance and sewer inspection programs as documented by the Water Pollution Control Federation are available and acceptable for implementation at Navy facilities. These manuals, together with existing Navy information , should form the complete base on which to build adequate maintenance and inspection programs for the pier systems to complement other shore side domestic sewer maintenance programs.

7. At present, there is no standard delineation of responsibilities for the shore side collection system from facility to facility. In some cases, the fire department is responsibile for the measuring of noxious gases and gas-free testing while in other facilities this activity is performed by the local public works department.

8. Currently there is minimal transfer of materials and information among the three local facilities in Norfolk. This proves to be relatively expensive in terms of duplicating efforts among the three facilities.

9. The increased use of garbage grinders is going to change the nature of ship generated wastewater. Updated information will be necessary when considering design criteria at other port facilities.

10. The critical point in the acceptance of and activation of the shipside CHT systems is the availability of shore side collection facilities. Experience gained during the ship activation program illustrated the need to educate and motivate shore side personnel

to ready collection systems as soon as possible. In some instances ships were prepared to offload only to find the shoreside system inactive.

6. RECOMMENDATIONS

1. Due to the relatively flat grade installation of most piping in all three facilities, it will be necessary to implement inspection programs which should be performed by a regular inspection branch of the sewer maintenance divisions of each public works department or center. Additionally, effective maintenance recording systems should be implemented at the three facilities for these sewers.

2. A priority study to gather fleet wide estimates of wastewater production rates should be considered. This study should incorporate a systematic monitoring of wastewater production for a large number of ships at pier side. The data derived from such a study can be used to determine more accurately the sewage treatment costs as 1981 approaches and the upgrade of information available in NAVFAC Design Manual (DM-5). The determination of peak flow in DM-5, for purposes of designing shore side collection systems, should mention that CHT systems act on an intermittent and short duration basis. This will provide a more realistic equastion for sewer design that will include more accurate daily volumes and maximum loading rates.

3. In order to provide regular determination and control of individual ship wastewater volumes, a simple and inexpensive sewage volume meter should be found to measure flows from each discharge hose at pier side. This will provide positive shore side control over excessive wastewater generation from shipboard operator error as explained in Part I of this report.

4. Where possible equipment stockpiling, pier maintenance programs, training, emergency repair teams, and hose maintenance should be regionally centralized to limit unnecessary duplication of facilities and personnel.

5. All shore side collection manholes and pier risers should be numbered to facilitate quick identification for maintenance and repair. Operation and warning plaques should be mounted at each pier riser as a guide for inexperienced workers and shipboard personnel in an emergency.

6. All activities should be directed to consider shore side collection as a priority goal to be met immediately. There is some concern as to the status of the systems relative to the 1981 goal of complete operation. This goal may be met only by establishing the importance of activating the systems to receive ships' waste as soon as possible as not to hinder shipboard system startup during the critical next two years.

7. It is also recommended that each activity establish good working relationships with local municipal treatment plant officers. This will serve to avoid misunderstandings as problems occur from treating shipboard wastewater.

APPENDIX A

STANDARD OPERATING PROCEDURES

FOR

NAVAL AMPHIBIOUS BASE, LITTLE CREEK, NORFOLK, VA.

NORFOLK NAVAL STATION, NORFOLK, VA.

NORFOLK NAVAL SHIPYARD, PORTSMOUTH, VA.

SHIP WASTEWATER COLLECTION SYSTEM

STANDARD OPERATING PROCEDURES

FOR

PIERS 56, 57, 58, 59, and QUAYWALL

U. S. NAVAL AMPHIBIOUS BASE, LITTLE CREEK

NORFOLK, VIRGINIA

TABLE OF CONTENTS

NAB, Little Creek

Norfolk, VA.

LIST OF FIGURES

1. INTRODUCTION

This manual presents standardized operating guidelines for shore side support of the ship wastewater collection system for Piers 56-59 and the Quaywall berths at the Naval Amphibious Base, Little Creek, Virginia. The sewers on the piers join and drain into a single pump station (Bldg. 3879). By considering these piers as a single system as described in this manual, the user will be better able to understand their common operating procedures and characteristics as well as their interaction during emergency situations.

This manual is intended to provide guidance for operating the Little Creek piers and to supplement NAVFAC manual MO-340 and existing instructions for local utility operating procedures.

1.1 Background

The Little Creek pier sewer system was installed by the 1974 MILCON project to enable the Naval Amphibious Base to comply with the Federal Water Quality Act of 1972 as specified in DOD Directive 6050.4. Details of the Navy's compliance are given in OPNAV Instruction 6240.3E for both the ship and shore side responsibilities in ship wastewater collection and transfer.

The pier sewers are designed to collect shipboard generated wastewater from naval vessels. Surface vessels and small craft either collect and hold wastewater with installed Collection Holding and Transfer (CHT) systems or, on smaller vessels, with Marine Sanitation Devices (MSD), which provide some onboard processing. The majority of vessels using the pier sewers on the eastern side of Little Creek cove will have CHT systems. These systems will be installed on nearly all Navy surface vessels by April, 1981. Properly equipped vessels are required to operate their systems prior to that date.

The operation of CHT systems with pier sewers has been well documented from field tests and extensive operating experience at other naval port complexes. The procedures outlined in this manual are field-proven from this rapidly growing base of prior experience as the number of activities accepting shipboard wastewater quickly increases.

General operating guidance for ship to shore sewage transfer hose connection, cleaning, and sanitation are documented in NAVFAC manual MO-340. Additional information and support is available from NAVFACLANTDIV Environmental Division and the Public Works Utility Departments of other Naval activities.

This manual briefly applies the recommendations in MO-340 specifically to Little Creek and is organized into the following chapters:

2. FACILITIES AND EQUIPMENT DESCRIPTION. Discusses the general purpose, layout, characteristics of ship generated wastewater, and details of pier piping layout.

3. SHIP WASTEWATER CHARACTERISTICS. Presents information on the contents of ship generated waste.

4. SEWER CAPACITIES. Presents data for the expected loading capacity of the sewer system from maximum ship berthing arrangements.

5. SEWER PROCEDURES - NORMAL. Discusses the additional procedures to be followed when connecting or disconnecting ships to these pier sewers.

6. SEWER PROCEDURES - EMERGENCY. Presents the emergency procedures to be followed for specific emergency conditions and recommended repairs.

7. HEALTH AND SAFETY. Provides personnel health and safety precautions in working with sewage transfer equipment and its maintenance.

8. MAINTENANCE. Presents a daily and regular maintenance schedule for the pier sewer system.

2. FACILITIES AND EQUIPMENT DESCRIPTION

2.1 General

The collection and transportation of ship generated wastewater to shore side treatment facilities involves several interrelated systems and activties. These are:

SYSTEM	ACTIVITY
a. The ship board sewage Collection, Holding and Transfer (CHT) system.	Ship
b. Ship to shore sewage transfer hose and fittings.	Ship/PWD
c. Pier sewer installations.	PWD
d. Sewage pumping stations.	PWD
e. Sewage treatment plants.	HRSD*

Figure 2-1 is a schematic of the ship to shore wastewater transfer components. Wastewater is collected and held by the ships' CHT system and pumped ashore through sewage transfer hoses to the pier sewer. The wastewater flows by gravity from the piers to other large buried sewer lines which connect other pier sewers. The sewage from all piers in the system flows to a single wet well and pump station. The pump station periodically pumps the collected ship sewage through a pressurized force main to the HRSD sewage treatment plant. The treated water is then discharged into the receiving water at the plant's outfall.

*Hampton Roads Sanitation District

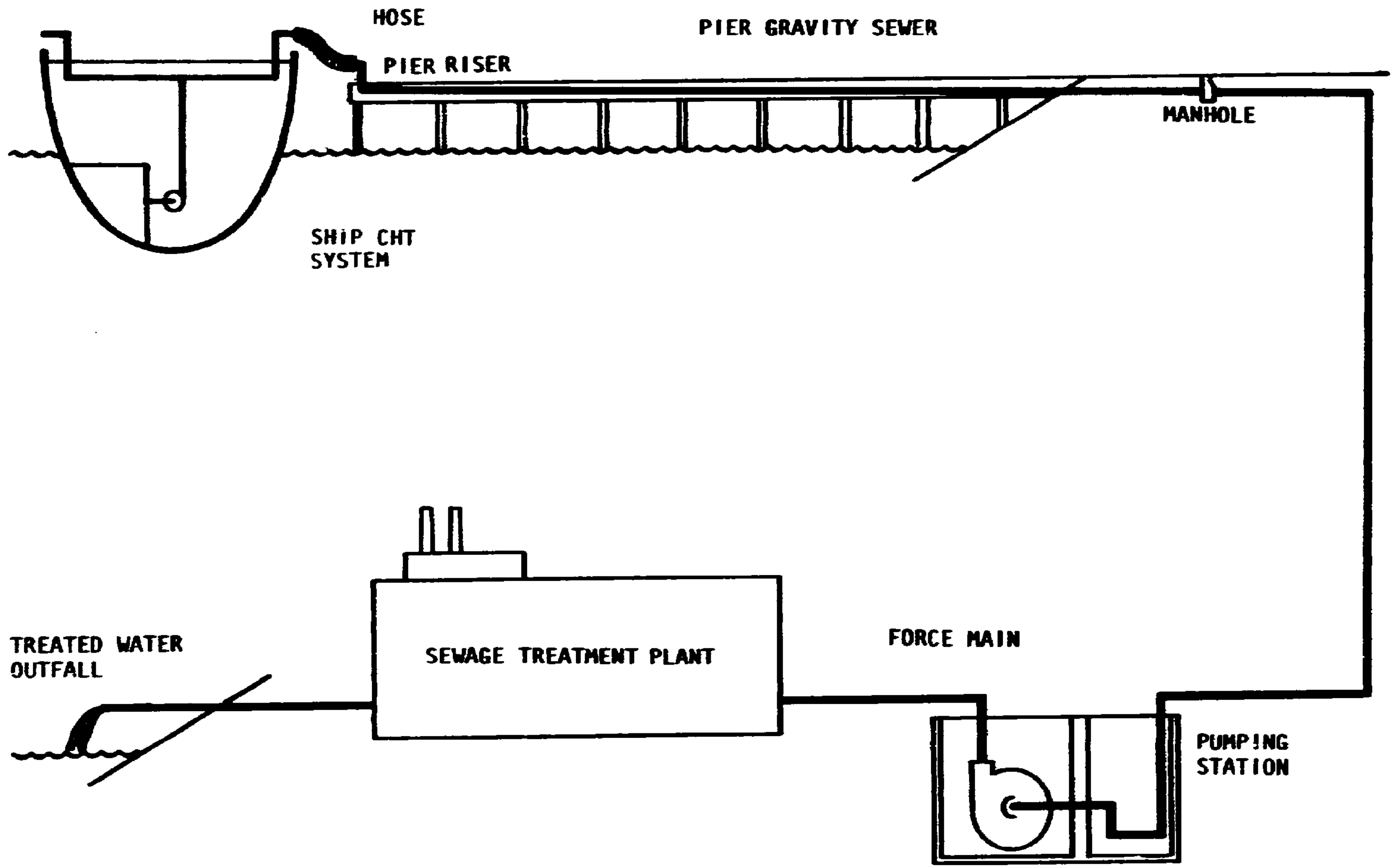


FIGURE 2-1. Sewer System Schematic

2.2 Pier and Quay Sewers

The pier and quay sewer system identified as piers 56, 57, 58, 59 and Little Creek Quay consists of 6850 lineal feet of 8, 10, 15 and 18 inch diameter exposed ductile iron pipe and buried vitreous clay pipe, manufactured according to specifications as detailed in NAVFAC Design Manual (DM-5). The total full volume of the system including collectors, laterals, and main sewer pipe is approximately 45,000 gallons with individual section full capacity flowrates ranging from 404 gpm (collectors to manholes) to 1,751 gpm (pier lateral to riser). Full capacity velocities of the larger 18 inch diameter sewer pipe sections leading to the pump station are 1.7 fps with maximum full pipe flow velocities occurring in the pier lateral piping sections connecting outboard risers to pier sewer lines of 7.0 fps.

The system is of the gravity sewer type with a main line (2897 feet) intersected at ten manholes along its route to the existing pump station (Bldg. 3879). These intersections, located along 6th Street, occur between pipe runs from 278 to 387 feet, sloped an average of 0.17%. Velocities along this main sewage line average 1.8 fps, which is below DM-5 minimum requirement of 2.5 fps to minimize solids settling.

Each pier has six ship to shore hose connection points, or pier risers, connected to the pier lines by lateral sections of pipe sloped and elbowed. As the pier line nears the LST wall, it is offset for clearance purposes and expansion/contraction compensated for by expansion joints. The total length of 10 inch diameter pier line (422 ft.) is installed with a slope of 0.4% producing a full flow velocity of 1.9 fps, below the DM-5 minimum. All lateral piping is sloped to produce full pipe flow velocities approaching 7.0 fps.

The Quaywall is outfitted with two separate collection pipe runs. The east-west section has eight pier risers and the dogleg section has four. The east-west quay berth area collection run consists of two primary sections east and west of the connecting line to Manhole One (MH 1). The west section is 867 feet with a slope of .33% producing a full flow velocity of 1.9 fps (below DM-5). The east section is 264 feet with 3.2 fps full flow velocity. The quay berth area referred to as the 'dogleg' also is separated by a collection pipe to MH 2. The southwest section is 48 feet with 3.9 fps. The capacities of all three quay berth areas is 5397 gals. (not including the collection lines to MH 1 or MH 2).

Ship to pier connection is made with camlock fittings accessible through the new hose coupler manholes. This fitting is a vertical 4 inch female coupler which is extended above pier level by 4 inch elbow adapters. When these are in place, the working height for hose connection is approximately 15 inches above pier level which prevents hose kinking and accidental spillage. All coupler manholes are stamped "SEWAGE" on top and are hinged for access to the below deck 4 inch female camlock fitting.

Figures 2-2 through 2-5 depict the sewer layout and selected details of the system and Table 2-1 details the specifics of pipe size, capacity and velocity.

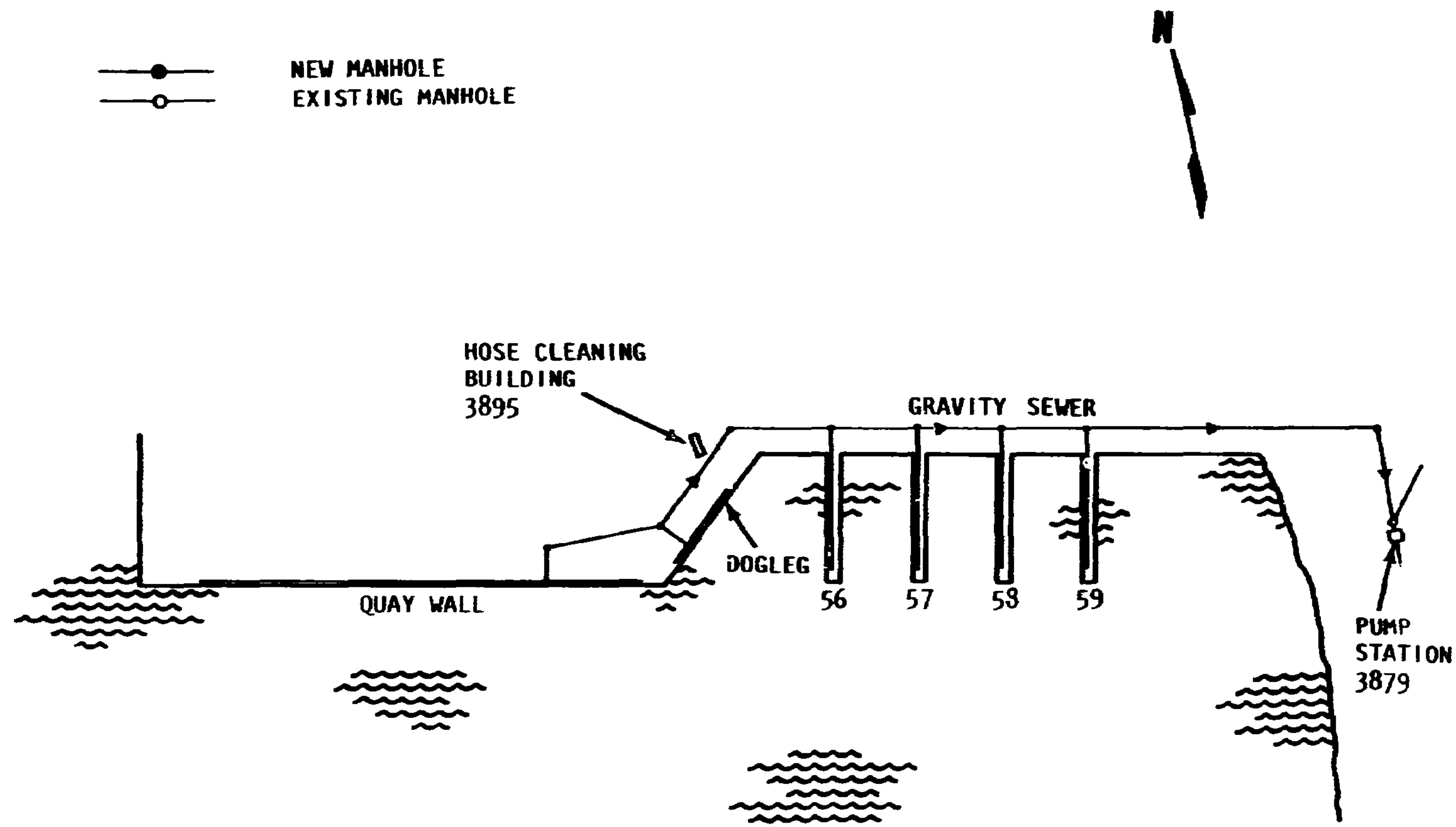


FIGURE 2-2. Receiving Sewer Layout

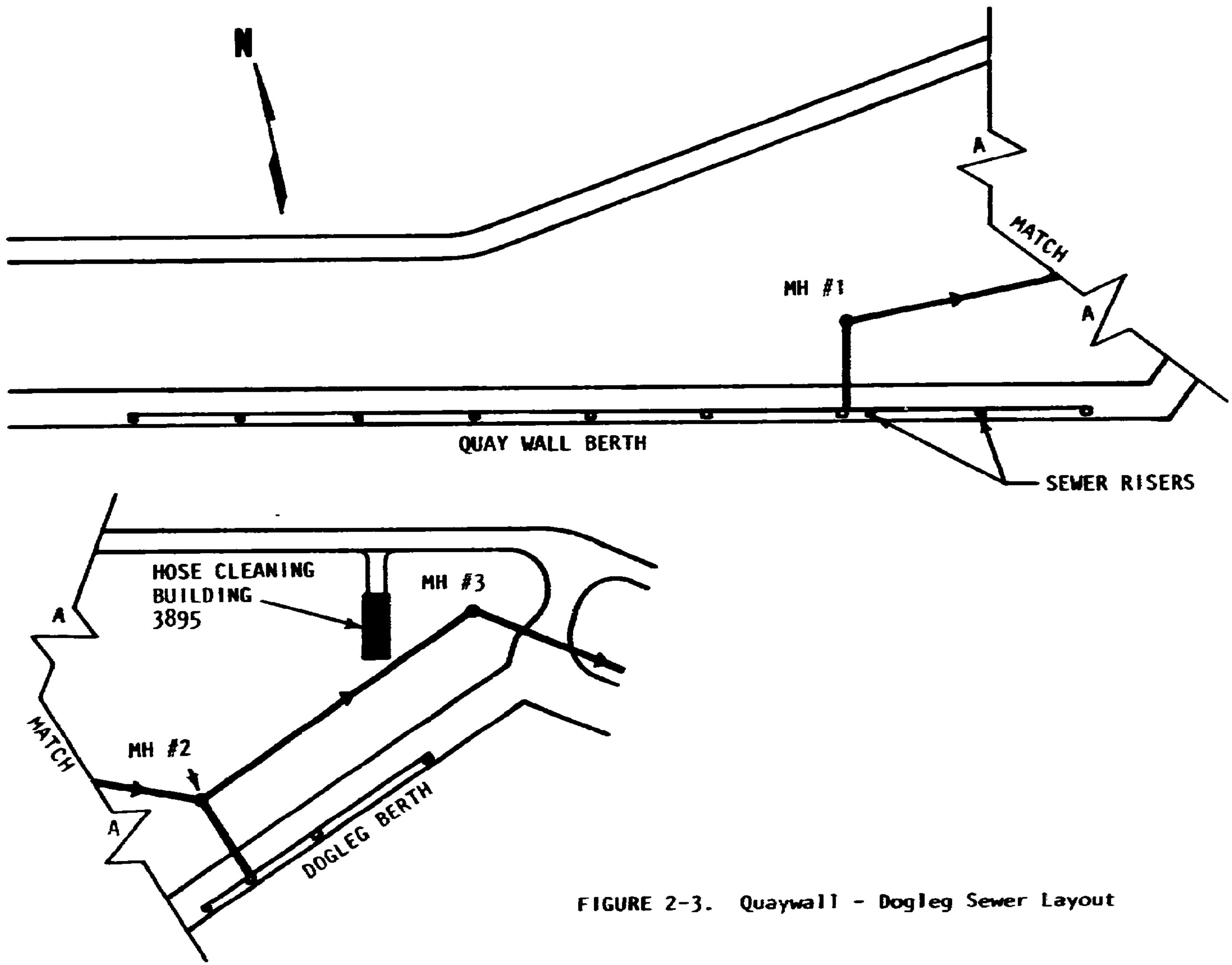


FIGURE 2-3. Quaywall - Dogleg Sewer Layout

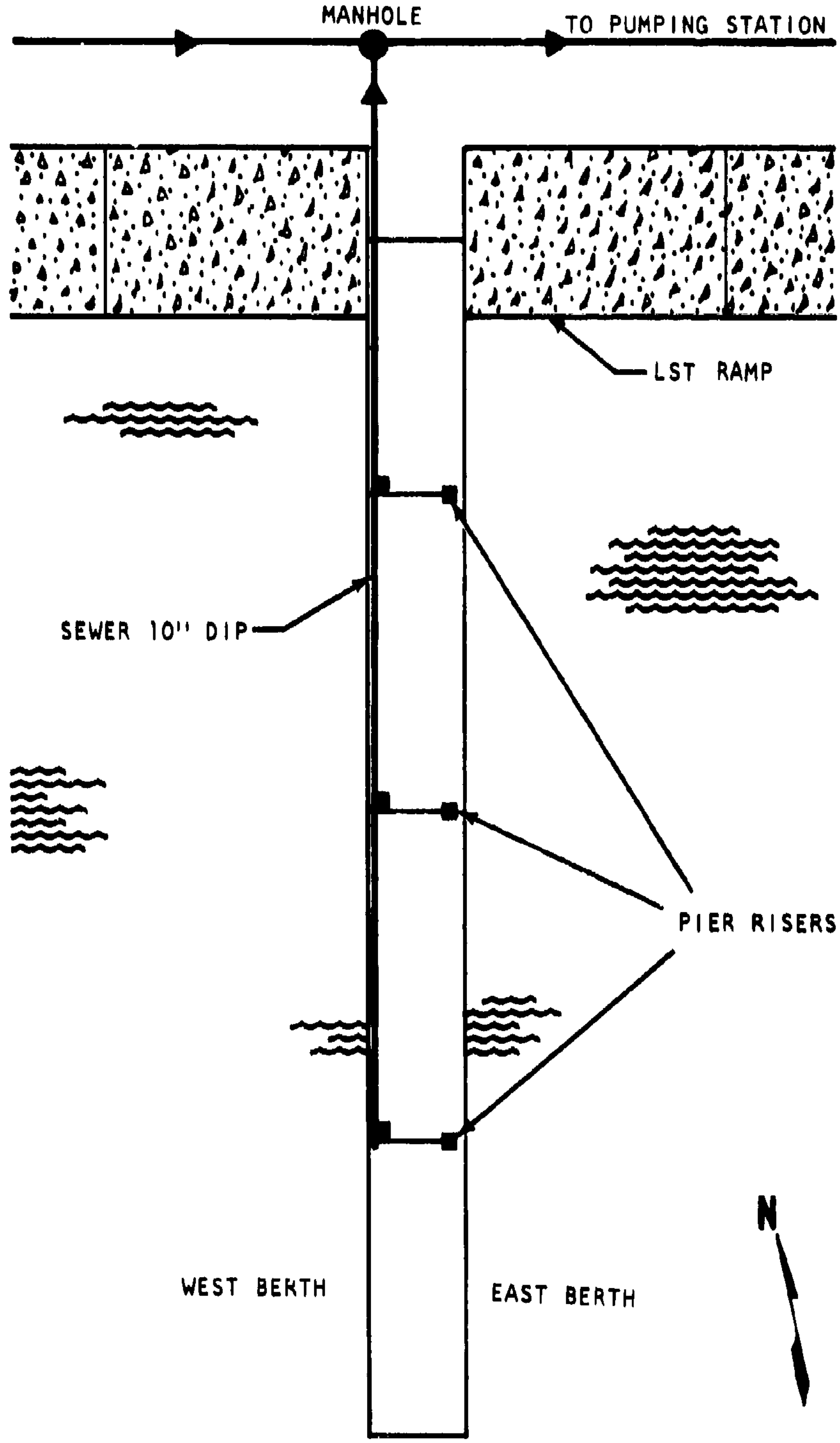


FIGURE 2-4. Pier Sewer Layout

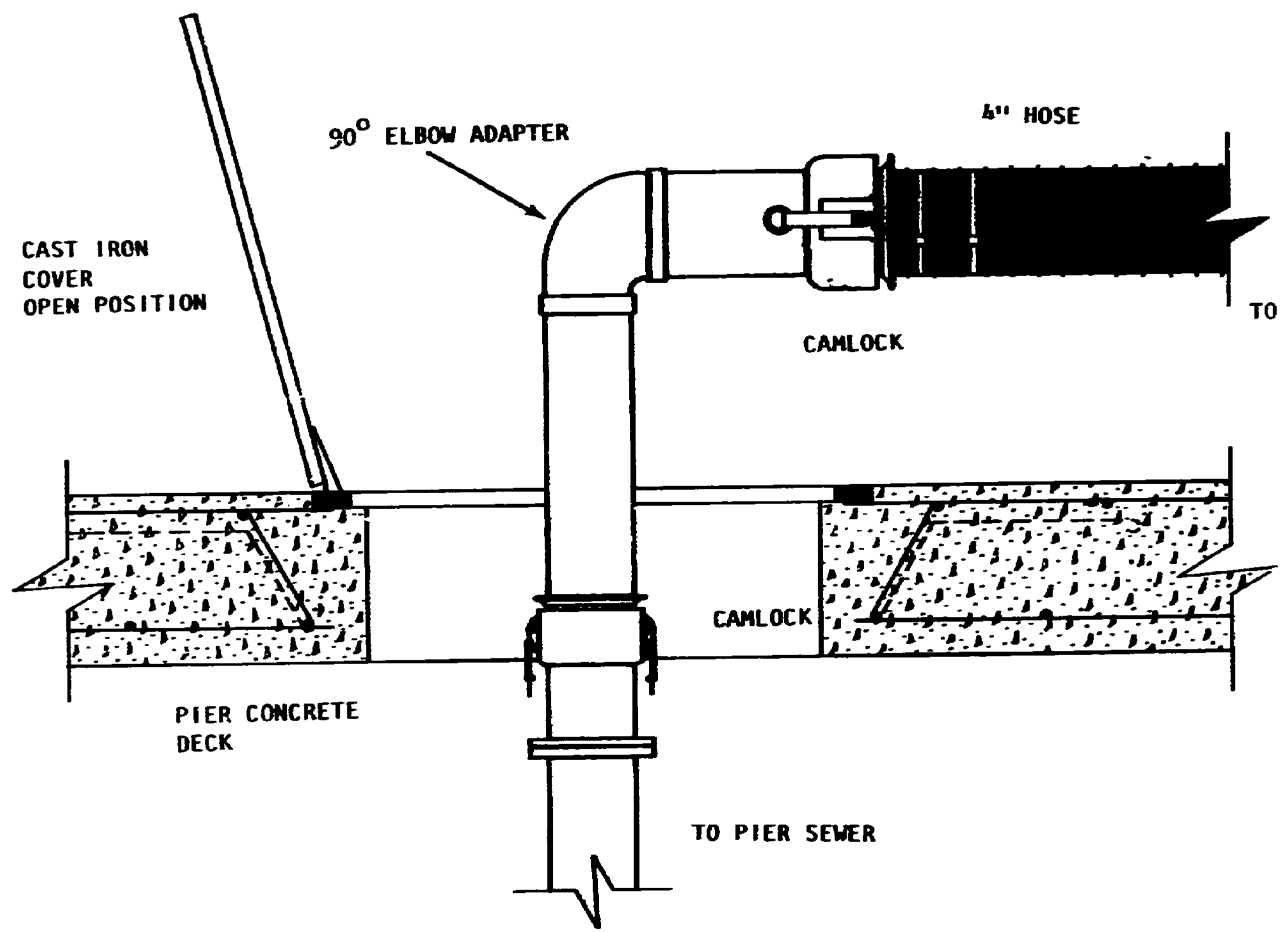


FIGURE 2-5. Hose Connection Cross Section

TABLE 2-1
LITTLE CREEK
DETAILS OF WASTEWATER COLLECTION SYSTEM

Location	Pipe Outside Diameter in	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
Quaywall	10	867	.33	3537	426	1.9
Quaywall	10	264	1.08	1077	763	3.2
Quaywall	8	48	6.38	125	1033	6.5
Quaywall	8	252	1.21	658	499	3.0
Collector 1	10	110	.29	448	404	1.8
Collector 2	10	110	.29	448	404	1.8
Pier	10	422	.40	1722	494	1.9
Pier	10	422	.40	1722	494	1.9
Pier	10	422	.40	1722	494	1.9
Pier	10	422	.40	1722	494	1.9
(12) Laterals	8	28	2.8-5.0	112	1257-1751	7.0
Sewer Sections	12	387	.23	2274	583	1.8
	12	379	.23	2227	583	1.8
	12	341	.23	2003	583	1.8
	15	278	.17	2552	988	1.8
	18	278	.17	2552	988	1.8
	18	278	.19	3675	1661	2.2

TABLE 2-1 (Continued)
LITTLE CREEK
DETAILS OF WASTEWATER COLLECTION SYSTEM

Location	Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
Sewer Sections	18	300	.13	3966	1437	1.7
	18	300	.13	3966	1437	1.7
	18	360	.13	4759	1437	1.7
	18	274	.13	3622	1437	1.7

2.3 Pump Station

The existing station (Bldg. 3879) is east of the pier structures near Helicopter Road (see Figure 2-6). It consists of a wet well room, wet well, 3 suction pipes, pump room, generator and motor room. The pump station due to its central location between the Little Creek piers and HRSD plant can also serve as a sampling point and intermittent and industrial waste removal station. Coincident to receiving pier side sewage, the pump station also collects sewage from buildings and other shore side structures through an existing 18 inch diameter sewer.

The wet well is accessed through a manhole cover and steel ladder extending approximately 17 feet down into the wet well and terminating adjacent to the 30 inch diameter inlet about four feet above the floor of the well. There are three pump suction intakes, with minimum suction levels at five and six inches above the floor.

The pumps are of the stand-up centrifugal type with the following capacities:

a. Pump #1 - 6" x 8" 770 gpm @ 35.5 ft. T.D.H. passing 4 in. solids.

b. Pump #2 - 6" x 8" 1050 gpm @ 27.0 ft. T.D.H. passing 4 in. solids.

c. Pump #3 - 8" x 10" 1350 gpm @39.0 ft. T.D.H. passing 4 in. solids.

The motors for pumps 1 and 2 are 15 H.P. @ 860 R.P.M., while pump 3 is operated by a 20 H.P. @ 860 R.P.M. motor. The pumps are operated by mechanical float actuators located in an 8 inch float cage along the interior wall of the wet well. The preset control liquid levels for each pump are:

	Level above floor level (ft)	
Pump	ON	OFF
1	6.8	3.8
2	7.3	4.3
3 (backup for pump #1)	6.8	3.8

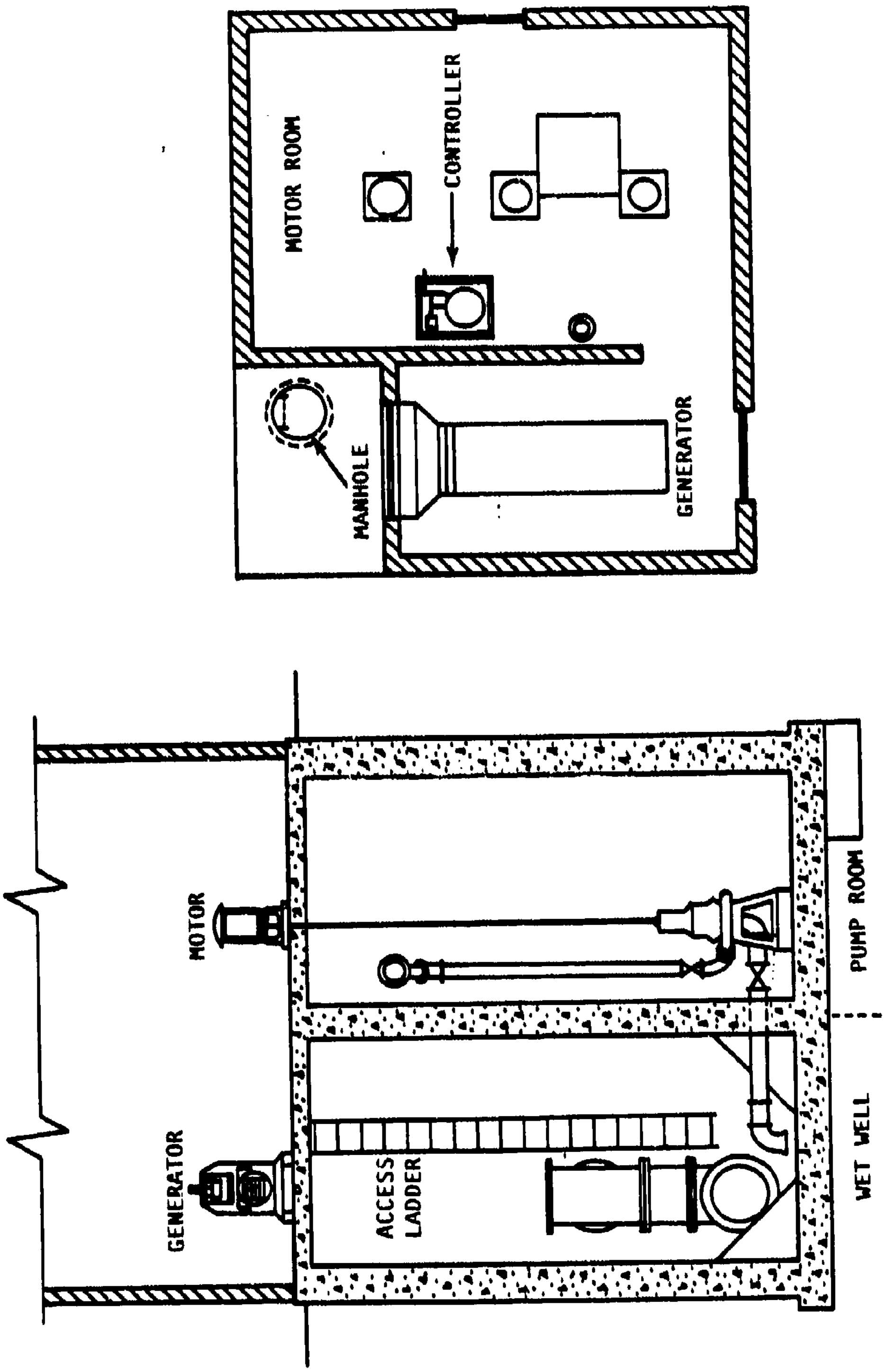


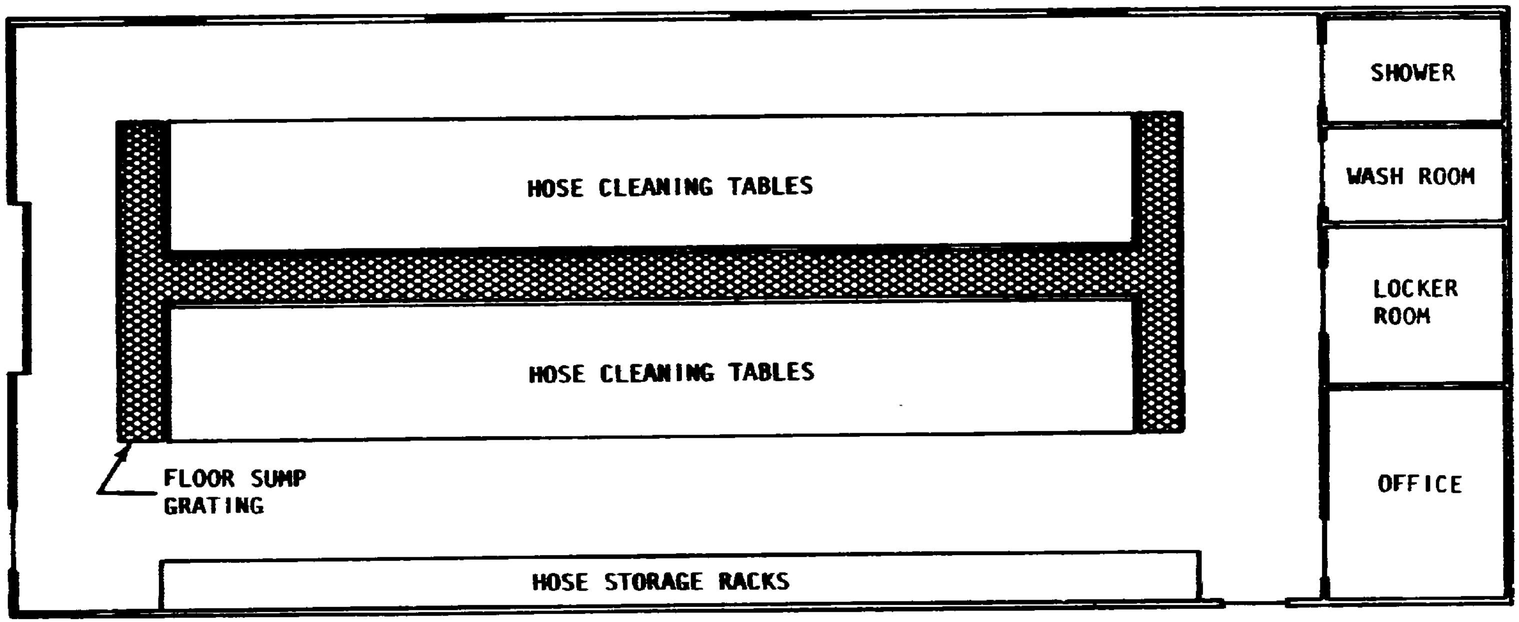
FIGURE 2-6. Pump Station

The sewage flow from both pier and shore-side sewer lines join at MH-9 approximately 33 feet north of the pump station, see Figure 2-2. Combined flow enters the wet well via the 30 inch diameter cast iron influent pipe.

The wet well room is fitted with an 8 inch cast iron vent pipe. The pump room has 1 1/2 inch vent pipes installed on each of the pumps and outlet to the wet well side. All pumps are mounted on concrete pedestals and equipped with outlet check and gate valves. In addition , a sump pump is situated below floor level and equipped with a 1 1/2 inch outlet pipe discharging into the adjacent wet well. Discharge from the three sewage pumps is conveyed through an 8 inch magnetic flowmeter and then into a 10 inch force main and subsequently to a 16 inch line joining the existing above ground cast iron force main located on the east side of Helicopter Road. The actual pumping head is approximately 22 feet. Access for service and maintenance on the pumps, piping and valves is by way of a stairway leading from the ground level motor room to the pump room below.

2.4 Hose Cleaning and Storage Building

The structure is located north of the quay berthing areas adjacent to 6th Street, see Figure 2-7. The facility has provisions for handling hose washdown and rack storage. It is placed so as not to impede traffic on piers and quays, and provides the advantage of a centrally located service and storage station. The building is outfitted with two hose washtables and a double tier storage rack for 34 coils of collapsible sewage hose. For washdown purposes, main supply steam and fresh water outlets are available. A sloped concentration trench serves to collect washtable runoff and discharges through a 6 inch cast iron soil pipe joined to a buried clay pipe which leads to an existing storm sewer. Personnel lockers, showers, laundry facilities and toilets are available along with office space.



BUILDING 3895

FIGURE 2-7. Hose Maintenance Building

2.5 List Of Pertinent Plan Drawings

The following drawings detail key points of the pier side collection system and are itemized here for future reference:

TABLE 2-2 PERTINENT PLAN DRAWINGS

DESCRIPTION	EFD DWG. NO.	NAVFAC DWG. NO.
Location map, vicinity map and general plan	114529	4014528
Wastewater collection system, plan and profile	114530	4014530
Wastewater collection system plan and profile	114531	4014531
Wastewater collection system, plan and profile	114532	4014532
Piers and quay wall details.	114533	4014533
Pier details	114534	4014534
Miscellaneous details	114535	4014535
Miscellaneous details	114536	4014536
Hose sanitation and storage building	114537	4014537
Location maps, index, and symbols	1306108	81208
Plans and profiles Helicopter Road	1306211	81211
Plans and profiles 6th Street	1306212	81212
Pump Station Helicopter Road at 6th Street	1306216	81216

3. SHIP WASTEWATER CHARACTERISTICS

Flushing water for shipboard sanitary systems is provided by the salt water firemain supply. As a result, the primary difference in ship verses domestic sewage characteristics is the chloride level. Generally, studies have shown that ship generated wastewater settles well and can be treated by normal biological treatment processes. Table 3-1 presents the characteristics of ship sewage from NAVFAC Design Manual DM-5. Also included are the results of wastewater tests on USS Portland (LSD-37) while at the quay wall berth.

Most of the ships' CHT systems have garbage grinder discharges into the collection systems. These tend to increase the suspended solids, BOD, grit, primary sludge and scum.

The monitoring of volumes of ship generated waste have shown that in actual practice the daily volume may be several times greater than the design standard of 60 gallons per man per day. These high flows are generally the result of a constantly flushing salt water source into the CHT system. Usually the ship is unaware of this flushing. Even with this greater volume, the fresh water dilution of Little Creek Cove should keep the chlorides below 11,000 mg/l.

TABLE 3-1

SHIP WASTEWATER CHARACTERISTICS

CHARACTERISTIC	DM-5 mg/l	PORTLAND (LSD-37) mg/l average
Total Suspended Solids	600	161
Total Dissolved Solids	20,000	--
Chlorides	11,000	2,972
Sulphates	1,500	--
Sodium	6,200	--
Other Dissolved Solids	1,300	--
BOD at 20° C.	400	167

4. SEWER CAPACITIES

The primary limitation to berthing arrangements at these NAB, Little Creek piers is the availability of shore power for shipboard requirements. Also, the berthing areas 59-E and 59-W are solely dedicated to Navy Diving School operations. This leaves the following active areas:

LOCATION	NO. SHIPS (LPD, LSD, LST)
Quay Wall-west	1
Quay Wall-east	1
Dogleg	1
Pier 56*	1
Pier 57*	1
Pier 58*	1

*Power limitations preclude berthing two ships at each pier (east/west).

4.1 Ship Sewage Production

The largest ships, in terms of sewage production, which are berthed at Little Creek, are LPD's, LSD's, and LST's. Table 4-1 presents a comparison of DM-5 ship sewage generation estimates and field data taken from ships berthed at NAB. The DM-5 uses a 60 gallon per capita day estimate. Recent field data has shown the daily rate to be closer to 144 gallons per capita day. The field data shown in table 4-1 does not include troops aboard the ships.

4.2 Expected Total Ship Loads

The pier sewer loading flow rates are based on a maximum berthing situation shown above. Table 4-2 estimates the sewer loading rates from maximum berthing of 2 LPD's and 4 LSD's using data calculated without troop complements.

The peak flow rate is a function of the maximum pump discharge rate and the average 24 hour rate for the multiple berthings of ships. For single ships, according to DM-5, peak flow rates are a function of the design discharge pump flow rates. What must be remembered about peak flow rate is that it occurs for a relatively short duration of 3 to 5 minutes. During this pumping cycle of about 400 gallons per ship, the sewer piping would have to fill up before the system would exceed its full pipe flow capacities. Table 4-2 shows that the shore side sewer system is capable of handling the average 24 hour flow rates but some sections may become pressurized during extreme peak flows for very short durations. It is unlikely that all peak flows will occur simulataneously, and field testing has shown that the peak flow rate from an individual ship is significantly reduced by discharge through the collapsible sewage hose.

TABLE 4-1

SHIP SEWAGE GENERATION - ESTIMATES AND FIELD DATA

DM-5*			FIELD DATA			
Ship Type	Complement	Avg. 24-Hr. Flow (gpd)	Ship	Complement	Avg. 24-Hr. Flow** (gpd)	Waste Generation Rate (gpcd)
ATF	80	4,800	ATF(Papago)	55	5,550	101
LKA	642	38,520				
LPD	1,487	89,200				
LSD	756	45,360	LSD(Portland)	387	10,486	39
LST	617	37,020	LST(Fairfax County)	200	12,474	129
			LST(Saginaw)	210	39,393	433

*Based on 60 gpcd generation rate.

**Normal daily volumes with high volume sources.

TABLE 4-2

SUMMARY OF PLANNED BERTHING DISCHARGE TO SYSTEM

LOCATION	SHIP*	Average 24 Hour Flow gpm. @ 60 gpcd.	Average 24 Hour Flow gpm. @ 144 gpcd.	Peak Flow 60 gpcd.	Peak Flow @ 144 gpcd.	Shore Side Capacity
Quay Wall West	LPD	16	40	635	635	583
East	LPD	16	40	635	635	
Dogleg	LSD	16	40	570	570	583
Pier 56	LSD	16	40	570	570	595
Pier 57	LSD	16	40	570	570	494
Pier 58	LSD	16	40	570	570	494
System	6	96	240	1270	1595**	1437

*Each complement about 400 men

**See DM-5, 5-10-6 for method of calculation.

5. SEWER PROCEDURES - NORMAL

5.1 Connecting Ships

The NAVFAC ship to shore hose handling MO-340 provides detailed tasks for ship to shore sewage connections for a variety of ships and circumstances. The following provides additional guidance for making connections to the Little Creek piers.

The first step in making a successful ship to sewer hookup is knowing the requirements of the ship for shore side supplied sewage transfer hose and fittings. A log book describing the requirements and pier use history for each ship should be developed and maintained as more and more ships begin using pier sewers. This log provides a ready reference to the hose handling crew to provide the proper length of sewage transfer hose and fittings for each ship request. A recommended format is shown in Figure 5-1.

The shore side hose handling crew requires at least two men. It is the responsibility of the shore side crew to meet with the ship CHT Officer to insure that his men are available and understand how to make the ship connections. At least three men are required aboard ship for this task. The ship hose handling crew are not expected to handle sewage equipment on the pier.

Safety, health and clothing requirement for sewage hose handling are detailed in Section 7 of this manual.

a. Sufficient hose lengths are laid out on the pier and connected with the female hose end tied to a heaving line for passing to the ship. The female end should be plugged at this time. This brass plug is recovered from the ship before the shore hose handling crew departs.

b. The pier sewer risers are located under hinged cast iron covers in the pier deck. The pier sewer is a continuous gravity system. The characteristic of gravity sewer systems is that collection piping does not run full and is, therefore, not <u>pressurized</u>. As a result,

SHIP LOG SHEET

SHIP: ____________________

DISCHARGE RISERS/SIDE: ____________________

HOSE SIZE: ____________________

EXPECTED GPD: ____________________

DIRECT HOSE FLUSHING AVAILABLE: YES ______ NO ______

CONNECT DATE	BERTH	RISER NO.	HOSE LENGTH	DISCONNECT DATE	TOTAL PUMPING DAYS	REMARKS

FIGURE 5-1. Log Sheet

the sewer riser fittings do not require valves and are secured only by the 4 inch camlock brass plug. Pumping tests on the quaywall system have shown that these pier risers are not pressurized during ship pumping. However, venting does occur through open risers and the operator may notice "breathing" from the open piping.

c. Because the pier riser fitting is set below the pier deck level, it is necessary to connect a 90 degree adapter fitting to the pier riser. This four inch camlock adapter fitting rises 15 inches above the deck surface to connect with the ship sewage transfer hose to prevent kinking of the hose. A photo of this sewer connection is shown in Figure 5-2.

d. To minimize chances of an accidental sewage spill, the shore crew must insure that the hose connection to the pier sewer riser is completed <u>prior</u> to the ship deck riser connection. Because the pier sewer cover does not lay flat on the pier decking, the hose connection is possible only from one direction. In most cases the adapter riser should be turned so that the connection is parallel to the length of the pier. By connecting the hose in this way the chances of hose kinking are reduced. Because of the problem with the pier riser cover it may be necessary to go to the next available riser using additional lengths of sewage transfer hose.

e. The open cover to the pier riser provides an unguarded opening through the pier decking. A <u>safety barricade</u> should be placed over this opening to clear the riser adapter. See Figure 5-3.

f. The last task for the shore side hose handling crew is to arrange the hose along the pier to minimize hose kinking, contact with steam lines, and away from the vehicle traffic areas. The hose should be examined for leaks as the ship begins pumping. If gaskets or hose sections then require replacement, procedures for hose flushing and draining as described in the following section should be followed before making repairs.

g. The pier riser adapter is secured to the camlock fitting by two metal tangs which secure the camlock ears. The vibration of this fitting and hose couplings during ship pumping can cause the locking ears to come loose. A safety band tied through the camlock rings prevents this.

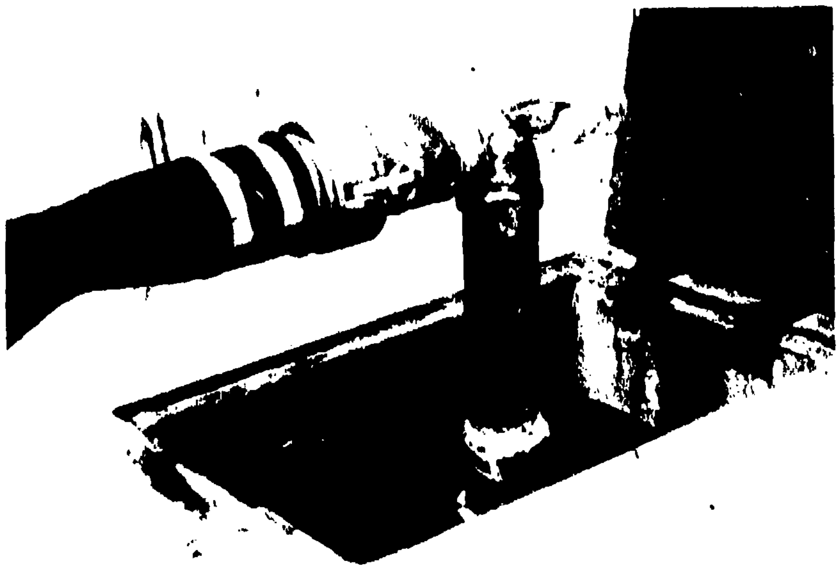


FIGURE 5-2. Riser Adapter

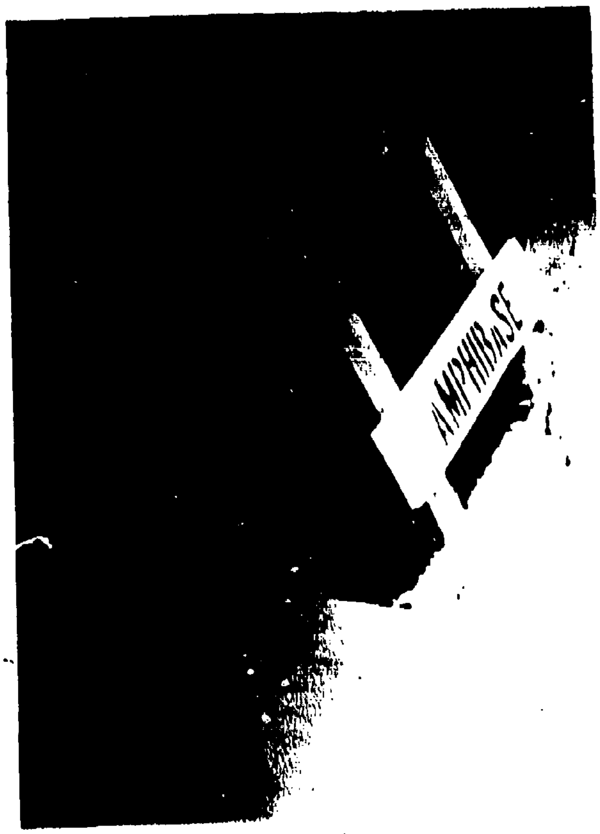


FIGURE 5-3. Safety Barricade

5.2 Disconnecting Ships

Detailed procedures for disconnecting sewage transfer hose from ships and other vessels is described in NAVFAC MO-340, Chapter 8.

a. The shore side hose handling crew should check with the shipboard personnel to insure that disconnecting procedures are understood and coordinated. At this time plugs for the four inch camlock hose should be provided to the shipboard crew. These will help prevent spills as the hose is lowered.

b. Ships have been instructed to flush the sewage transfer hose with salt water from the firemain connection installed in their CHT discharge piping. This flushing of the hose for 10 minutes is all that is usually required to clean sewage transfer hose. The shore crew should check with the ship to be sure that this flushing has been accomplished. Some ships are unable to provide direct salt water flushing. The shore side crews should be aware if the ship is unable to provide properly flushed hose. All ships soon will be fitted with this direct salt water flushing capability.

c. After flushing, the ship disconnects from their deck riser and drains the hose by allowing it to vent through the open fitting. At this time the shore crew should raise the low spots of the hose to allow it to drain into the sewer. Only after all draining is accomplished is the hose plug installed on the open hose.

d. The hose is disconnected from the pier riser only <u>after</u> it has been lowered to the pier. Hose, caps and plugs should be <u>removed before</u> the hose is coiled and placed in storage. This will allow the hose to vent while on the rack.

e. The pier riser adapter is removed whenever the sewage hose is disconnected and the sewer riser plugged when not in use.

f. While the hoses and fittings are laid on the pier, the hose handlers should inspect all fittings and hoses for damage and separate them for maintenance. Properly flushed sewage hose can be immediately used for other ship connections without further cleaning or maintenance.

5.3 Small Craft

Pier sewers will accept sewage from small craft and Sewage SWOB barges. At this time there has been little experience with procedures for these craft. They will be developed and included in NAVFAC MO-340.

5.4 Sewage Transfer Hose

There are several types of sewage transfer hose available for large ships, submarines and small craft. Large ships with CHT systems use standard 4 inch camlock fittings on 4 inch hoses. Submarines use a 2 1/2 sewage hose with camlock fittings and small craft use 1 1/2 inch camlock fittings and hose. Only sewage transfer hose has the camlock fitting which prevents its use in other utility services. The hose is clearly marked "SEWAGE".

Sewage transfer hose comes in two designs. Originally all facilities were outfitted with the 4 inch collapsible hose (50 foot--130 lbs. MIL-H-20176). A rigid wall, wire reinforced gravity transfer hose is presently available (MIL-H-20176D). Five years of continuous service life for these hoses should be expected.

The collapsible hose is suitable for all sewage transfer operations. However, the operator will note that it kinks easily and can shut off the flow from the ship. Additional care must be taken to prevent hose kinking, particularily with rise and fall of the tide. Additional 90-degree elbows, temporary hose saddles, and tie-offs may be necessary. Ship hose connections should be regularly inspected by utility crews to insure that kinking has not occurred.

As ships are pumping sewage, the collapsible hoses will pulse. This pulsing can quickly cause chafing of the hose and severe damage without proper precautions. This is particularly severe where the hose passes over sharp concrete pier curbing.

6. SEWER PROCEDURES - EMERGENCY

As the pier sewer systems become a regular part of ship provided utility services, these pier sewers must be kept operating with a minimum of service disruption in the event of system failure. This section provides some guidance as to the problems that may be encountered in repairing the pier sewer system and some methods to restore pier sewer service as quickly as possible with a minimum of disruption to shipboard operation.

6.1 Sewer Line Break

The pier sewer systems are interconnected to a common sewer main and lift station. This interdependence complicates the effect of a sewer line break or major leak throughout the entire system. Pier sewer breaks have occurred on similar pier sewer systems. Emergency repair procedures should be well understood and rehearsed before they become necessary. It should be noted that most of the pier sewer piping is submerged at high water. Thus the greater cause of concern is the uncontrolled entry of sea water into the pier sewer system to the pumping station. To comply with discharge permit regulations, the gravity overflow bypass at the pumping station and a sluice gate valve were removed. As a result it is difficult to isolate the pumping station in the event of a major sewer line break.

Pier sewer breaks may occur for the following reasons:

1. The underpier sewer is hung close to the pier fender piling and can be damaged from docking impacts.
2. Fender camels can become wedged under the pier sewer piping and crack the piping as they rise with the incoming tide.
3. Gradual saltwater corrosion can weaken sewer pipe flanges and expansion joints.

4. Seasonal ground settling can cause buried pipeline cracks, resulting in infiltration of ground water. These cracks would not usually result in massive sea water intrusion but should be identified and repaired to limit unnecessary treatment plant processing of ground water.

If a major break occurs in the pier system it will be necessary to physically isolate that pier sewer from the rest of the system. A pier sewer line can be most easily isolated with the use of a sewer plug. Typical sewer plugs are shown in the photos. Figure 6-1 is an air inflatable bladder type plug. Figure 6-2 is a mechanical screw expandable plug. Figure 6-3 is an air inflatable rubber plug.

The most common pier sewer plug required will be the 10 inch plug for the ductile iron pipe connected to the manhole from the pier sewers. It may be necessary to delay the use of the sewer plug until a suitable tide level occurs. Figure 6-4 shows various tide levels with respect to pier piping and the deepest manhole.

The following sequences should be followed by Public Works Department utility division in dealing with a major break:

1. Upon notification of discovery of a pier sewer break the ship up line of the break should be notified to secure sewage pumping. At the same time, Port Operations should be notified to provide sewage SWOB barges (if available) for the ship or alternative pier berths.

2. Notify HRSD of increased saltwater content of wastewater. This will give them opportunity to divert some of the waste and provide additional holding and mixing time.

3. Identify appropriate manhole for sewer plug. Prepare the necessary equipment for manhole entry and notify Fire Department to provide a gas-free inspection of the manhole.

4. Determine appropriate tide level and time from Port Operations when sewer pipe may be accessible from the manhole.

5. Install sewer plug.

FIGURE 6-1. Air Inflatable Bladder Plug

FIGURE 6-2. Mechanical Screw Expandable Plug

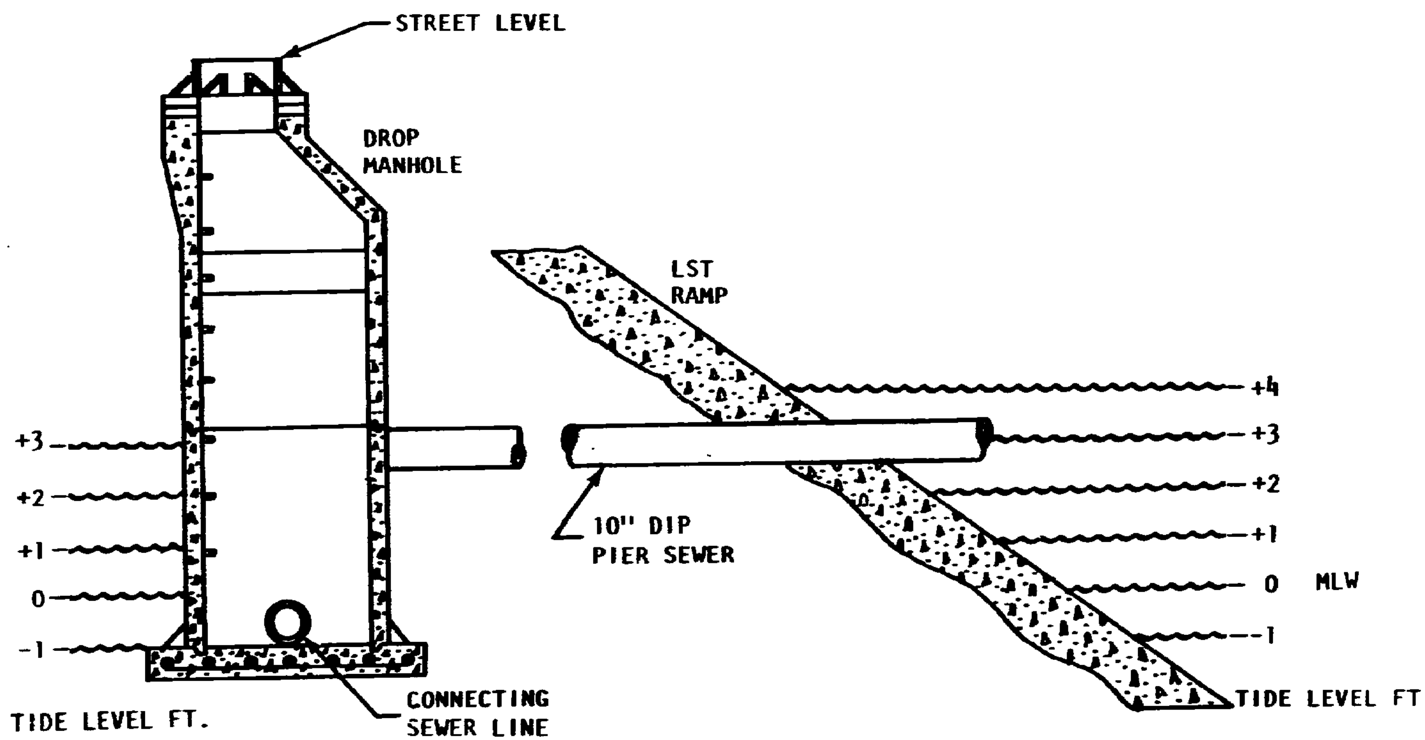


FIGURE 6-4. Sewer and Tide Levels

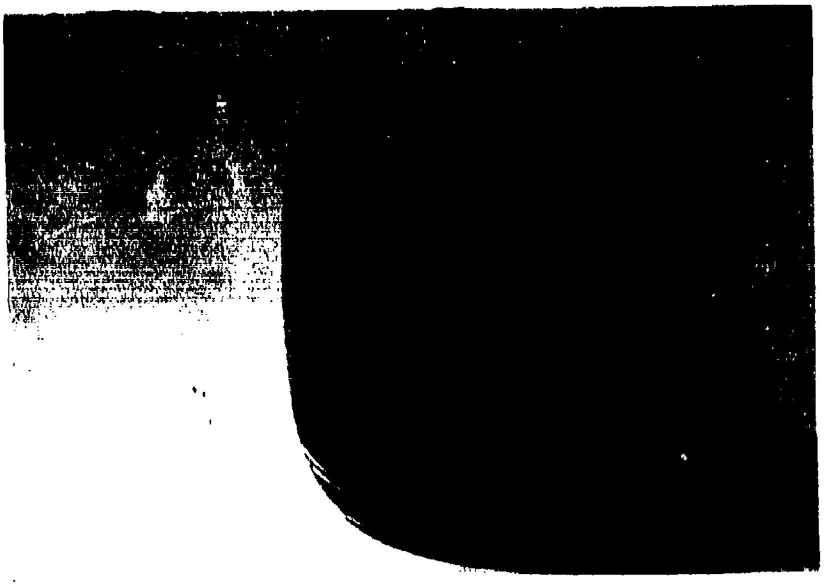


FIGURE 6-3. Air Inflatable Rubber Plug

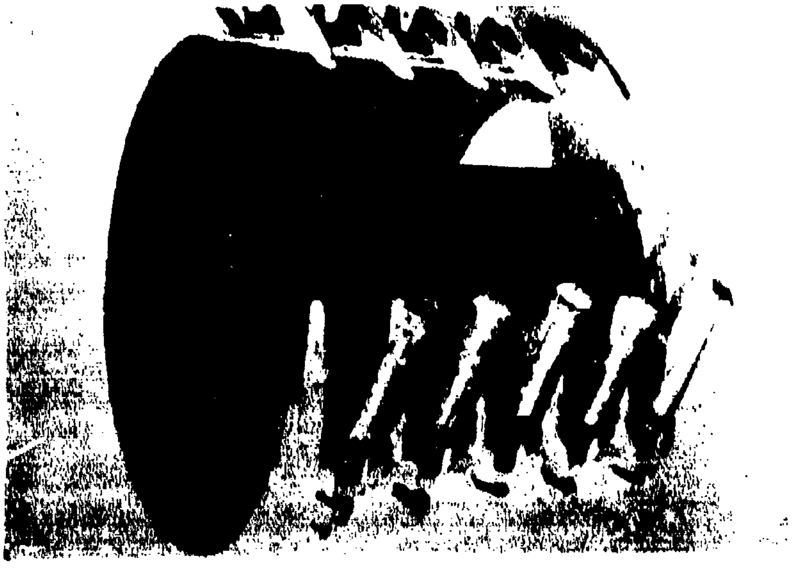


FIGURE 6-5. Mechanical Pipe Patch

6. Notify HRSD of reduced saltwater content in wastewater.

After initial emergency plugging it may be possible to take some corrective action to provide a temporary fix for the broken pier piping. Small leaks and breaks may be repaired by use of a mechanical pipe patch as shown in Figure 6-5.

The repair of broken pier sewer piping should be treated as an emergency and contracted accordingly. Sources of repair pipe and contractors with suitable equipment should be identified beforehand.

Sections of pier piping may be usable if the isolation plug is installed at the site of the pipe break. This will allow at least a portion of the pipe sewer to be used and additonal sewage transfer hose can be provided to the ship so it may pump to the nearest available sewer riser.

It is possible to run additional hose lengths from the ship to the nearest available manhole. The ship pump out time will be increased only slightly.

Waterfront operations must be kept informed of pier sewer repair conditions so that they may provide alternative berthing arrangements. Ships equipped with sewage transfer systems will be required to berth at piers with collection capability.

6.2 Industrial Waste Intrusion

Pier sewer systems have been used as a convenient but improper way to dispose of a variety of industrial waste from ships. These have included oil wastes, paint and paint thinners, boiler cleaning compounds and a variety of shipboard hazardous materials. These wastes are usually first noticed in the sewage wet well and can be traced via the pier sewer line to the suspected source. If intrusion is noted, action to remove the material must be taken. HRSD should be immediately notified so that they can monitor their influent and take action to protect their treatment process. PWD has two pump trucks available equipped with suction hose pumps and a storage capacity that can be dispatched to the sewer wet well. If evidence of hazardous material exists in the sewers they must be flushed by fire hose while collecting the material at the sanitary wet well through the access manhole.

Industrial waste material and flammable liquids enter the pier sewer piping only through the pier riser connections or directly into the manholes. Material spills into open areas that reach storm drains will not reach the pier sewer system. In most cases these drains discharge into the harbor.

In the event of flammable material entering the sewer system, the NAB Fire Department can be notified and requested to inject aqueous film-forming foam (AFFF) into the pier sewer piping, manholes or sanitary wet wells as necessary. AFFF is a toxic material and its use should be regulated to prevent damage to the systems at the HRSD plant. Also, ships which are required to regularly test AFFF mixtures should be directed to alternative disposal methods.

6.3 Electric Power Failures

The pump station (Building 3879) is equipped with a 75 KW emergency generator that is automatically activated as a result of base power failures. This emergency power will provide sufficient pump power for the requirements of the pump station.

It is a usual practice of ships berthed at Little Creek to use shore supplied power. In the event of shore side power failure the ships will change to onboard emergency generators to provide partial ship power. It is the usual practice, however, that sufficient power is not made available to ship sewage transfer systems (CHT). Therefore, ships will not be usually pumping to thepier sewer system in the event of shore side power failures.

If the pump station emergency power fails, ships connected to the system should be requested to divert their systems or begin holding until the power failure problem has been corrected.

6.4 Sewage Spill Procedures

Sewage spills on open areas of piers most frequently occur from sewage hose failure, improper hose connection procedures or vehicle damage to the pier riser fittings. The first concern in responding to a sewage spill is to keep personnel away from the area. Stop the source of the spill and flush down the area as quickly as possible. More detailed procedures are discussed in the following health and safety section.

6.5 Emergency Notifications

Any of the above emergency situations require the notification of the following:

1.	Port Operations Duty Office	Tele:	-7791
2.	PWD Duty Officer		-7238
3.	Hampton Roads Sanitation District (HRSD) Chesapeake-Elizabeth Plant		464-6448

7. HEALTH AND SAFETY

The operation and maintenance of ship to shore sewage transfer systems is no more hazardous than any waterfront operation. The safety and health precautions for this work are mostly a common sense approach. Historically, workers in the maintenance of sewer systems and the operation of treatment plants have enjoyed an excellent health and safety record. Workers with the ship to shore sewage transfer system should be aware of the following health and safety precautions.

7.1 Health Precautions

Clothing. The following list of clothing is that suggested for most routine operation and maintenance procedures. Clothing should be washed frequently and a spare set of work clothes or coveralls available in a locker to provide a fresh change of clothing if necessary. No special segregation of this clothing is necessary for washing and can be washed with regular home laundry loads or in the machines available at the hose cleaning facility.

Hardhat. An approved safety hardhat is required for all work pierside.

Work clothes. Regular work clothes or coveralls are all that is required for exterior clothing and working with sewage transfer hose. Coveralls and waterproof aprons are recommended when cleaning hoses or working with wet equipment.

Rubber gloves. A short pair of heavy duty rubber gloves is to be worn while handling sewage hose and equipment.

Work shoes. Steel-toed work shoes must be worn at all times while handling sewage transfer hose and fittings and performing maintenance tasks. Steel-toed rubber boots should be worn while making hose disconnects or when in wet sewage environments. (wet wells, manholes or sewage spills).

Washing up The most important health precaution to regularly follow is remembering to wash hands and face after handling sewage equipment prior to eating, smoking, or drinking. This must become a regular habit of all sewage transfer workers. Hand washing and shower facilities are available in the hose cleaning building.

Health records The base dispensary should be requested to mark the health records of personnel working with sewage transfer equipment with the following notice: "Occasional Contact With Sewage".

Shot records BUMED has recommended that the normal series of inoculations be maintained for all personnel working with sewage equipment. These are tetanus, typhoid, and polio. These inoculations, if kept up to date, should provide a sufficient level of protection to the worker. Workers should be particularly careful with open cuts to keep them clean and dry to prevent infection. The dispensary should be visited for treatment for any infections, sewage in the eyes, or any abnormal health condition that may occur.

Potable water connections Personnel working with sewage transfer equipment must not then also make potable water connections. If it is necessary to connect to a water hydrant to hose down an area from a sewage spill, a different man should be called in to make this connection and handle the fresh water hose.

7.2 Safety Precautions

Pier operations The shore crew for sewage transfer hose connections and disconnection procedures requires at least two men. The coiled hose lengths weigh approximately 150 pounds with the brass fittings attached. It is therefore necessary to insure that at least two men lift the heavy coils on and off the truck. Hardhats are necessary while on the piers particularly when the hose is raised and lowered to the ship. The sewage transfer hose is impossible to lift unless properly drained prior to disconnect. A safety barricade must be placed over the pier riser opening while a sewage hose is connected (see Figure 5-3). Additional hose handling precautions are discussed in MO-340.

Manhole and wet well entry. The following equipment is necessary for safe entry into a sewer manhole or sanitary wet well.

1. Safety barricade.
2. Safety harness and lifelines.
3. Ladder.
4. Explosion proof lighting.
5. Manhole lifter.
6. Portable ventilating blower.
7. Gas detecting equipment.

The instructions for entering a sanitary (sewage) wet well are contained in Public Works Department Instruction 5100.2. This instruction requires a gas free permit issued by the base Fire Department prior to entering a manhole or sanitary wet well. Figure 7-1 shows the equipment necessary for manhole entry.

Figure 7-2 shows the use of a gasoline powered portable blower for ventilation prior to entering the manhole.

Figure 7-3 shows three types of gas sampling meters. An explosive atmosphere meter and a SO_2 meter are shown. The base Fire Department uses a combination explosion and oxygen deficiency meter shown on the left.

At least two men are necessary to handle the safety line for the man entering the manhole as shown in Figure 7-4. A full-body safety harness is necessary and is maintained by the Public Works Department safety locker.

The ladder rungs installed in manholes are particularly subject to corrosion because of the corrosive atmosphere of the saltwater sewage in these sewer systems. These ladder rungs should be inspected for deterioration and tested with a hammer. If necessary, the manhole should be entered by a supplemental portable ladder if there is any question.

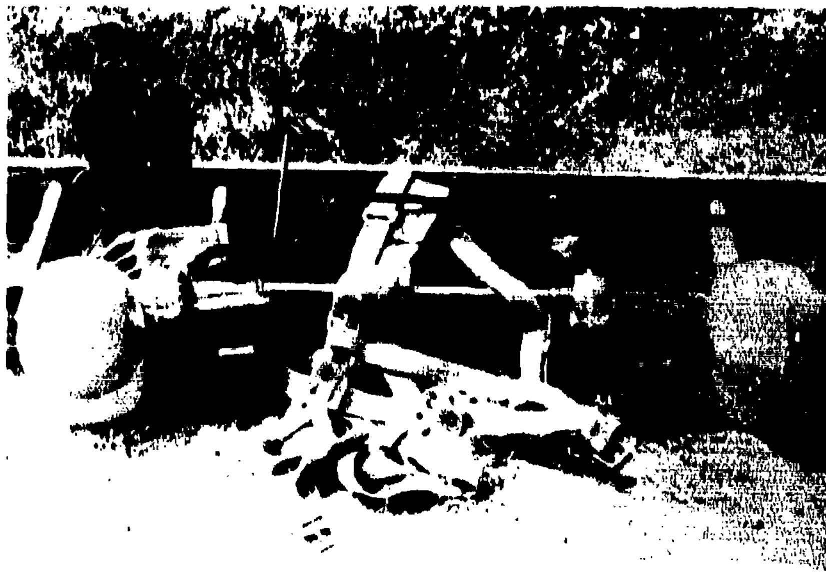


FIGURE 7-1. Manhole Entry Equipment

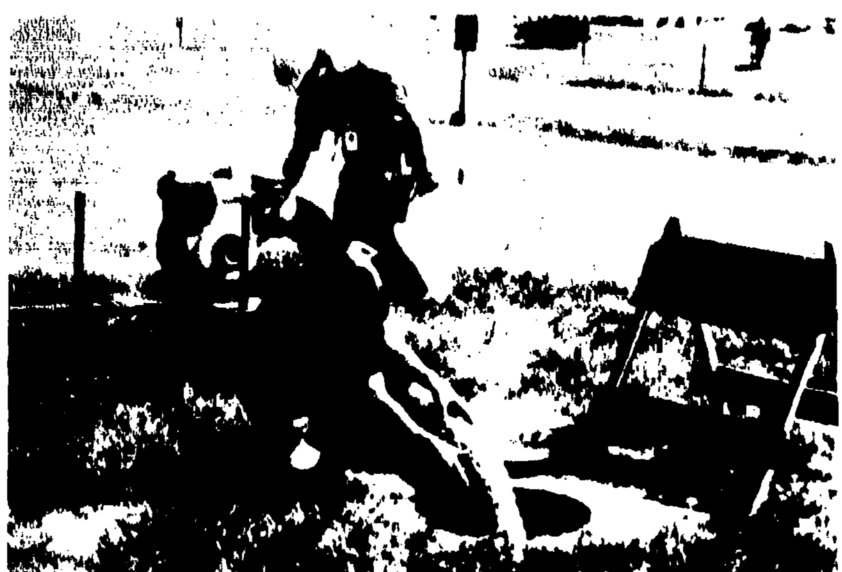


FIGURE 7-2. Gasoline Powered Portable Blower

FIGURE 7-3. Gas Sampling Meters

FIGURE 7-4. Entry Procedures

The presence of explosive and toxic gasses and an oxygen deficient atmosphere in manholes should be of constant concern to sewer maintenance workers. These gasses cannot be detected by smell and must be regularly tested by the proper sampling meter. If there is any doubt on the condition of the atmosphere within a confined manhole, force ventilation should be provided.

7.3 Sewage Spill Clean Up

Sewage spills are most likely to occur around the pier sewer connection riser and immediate pier deck area. These are usually the result of insufficient hose drainage prior to disconnect, leaking hose gaskets, hose rupture or a ship pumping through a disconnected sewage hose. The basic procedure is to flush the area clean. The following procedures should be used and adapted for various sizes of sewage spills.

--Secure source of spill.

--Close off area to unnecessary traffic and personnel.

--Flush area with fire hose - salt water from ship hose is preferred.

--Use disinfectant or detergent to cut odor or grease if needed. (Use a dry phenolic compound or any stock detergent)

--Flush area again.

--Open area to regular activity.

The disinfectant recommended in MO-340 is a disinfectant, germicidal, fungicidal concentrate (phenolic dry type) stock number 6040-00-753-4797. HTH chloride is not recommended for use around piers or when it may come in contact with grease or oil.

8. MAINTENANCE

The maintenance of pier sewer systems will become part of the regular sewerage system maintenance on the base. The design and installation of the pier sewer system is similar to that of domestic sewers. However, there are some differences and precautions to be noted in the maintenance of this system. The following sections highlight particular problems with pier sewer maintenance.

8.1 Regular Maintenance

The increased chloride level of ship generated waste will aggravate the effects of corrosion on the pier sewer system. More rapid deterioration will occur in the cast iron pipe sections, mechanical joints and manhole ladders.

Regular daily inspections of pier sewer system is important to insure continued trouble-free operation. The following daily inspections should be made:

a. Sewage transfer hoses from ships pumping into the pier sewers should be inspected for tight camlock connections, leaks around gaskets and fittings, kinks in the collapsible hose, excessive weight from catenary bends and contact with hot steam lines and hose chafing.

b. While ships are pumping into pier sewers, whenever possible, visual inspection of the exposed under pier collection lines should be made to observe any damage or leaking. This inspection is best accomplished at low tide when all the under pier piping will be exposed.

c. The pumping station wet well should be examined for evidence of oil or excessive grease buildup. If oil or chemicals are present, pier sewer manholes should be examined to see if the source of the pollutant can be isolated.

Less frequent inspections should be made at least weekly or as they occur in the following areas.

a. When no ships are using the pier system a manhole should be opened and any sewer flow should be observed to determine the rate of infiltration. This would be best accomplished during high tide at maximum submergence of the pier piping.

b. As damage to pier fender piling occurs the under sewer piping should be inspected for damage and evidence of leaking.

8.2 Regular Sewer Maintenance

The majority of the east side pier system has full pipe flow velocities less than the design standard in DM-5 of 2.5 feet per second. Table 2-1 lists the velocities for each section of sewer pipe. It should be noted that most of the pier system has velocities in the range of 1.5 feet per second. As a result, these portions of the sewer system may quickly accumulate solids buildup as the low flow rates allow the sewage to settle in the pipes. As the frequency of pier sewer use increases, at least quarterly inspections of these sections of the sewer system will be necessary to determine the rate of sludge buildup. Inspections of manholes should include observation of excessive oil, the amount of sewer gas, infiltration and pipe blockage. As sewer solids buildup occurs line flushing and cleaning will be required.

Extreme care should be taken during excessive cold weather periods which may cause line blockage from ice formation. It is the nature of CHT operation that the pier sewer is regularly dosed with about 300 gallons of sewage from one pump firing. This dosing will occur very infrequently, particularly during the coldest hours in the early morning. The flow from the ship is not constant and this intermittent loading may facilitate rapid ice buildup in the sewer lines. Until sufficient experience with cold weather operations is gained, extreme care should be taken when the system is used in cold weather.

The pier piping should be inspected yearly for damage and the condition of exterior coating. Pier risers along with camlock fittings, gaskets, plugs and riser manhole covers should be inspected and maintained as necessary. Working camlock gaskets in the pier risers and hose require replacement about yearly to maintain tight leak-free connections.

8.3 Hose Maintenance

Regular maintenance procedures for sewer transfer hose are outlined in MO-340. Normal flushing of sewage hose with ship saltwater flushing connections will provide sufficient cleaning of the sewage hose prior to disconnect. The most important maintenance function to be performed on the hose is routine inspection prior to hose storage. Hose with evidence of leaks or excessive abrasion should be removed from service and the bad section cut out by shortening the hose length, if possible. For hose in continuous service MO-340 recommends a hydrostatic pressure test to 100 psi at least every 90 days.

SHIP WASTEWATER COLLECTION SYSTEM

STANDARD OPERATING PROCEDURES

FOR

PIERS 20, 21, 22, and 23

U. S. NAVAL STATION,

NORFOLK, VIRGINIA

TABLE OF CONTENTS

U. S. NAVAL STATION

NORFOLK, VA.

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

This manual presents standardized operating guidelines for shoreside support of the ship wastewater collection system for piers 20-23, Destroyer and Submarine Piers, at the Norfolk Naval Station , Norfolk, Virginia. The sewers on the piers join and drain into a single pump station (#3). By considering these piers as a single system, as described in this manual, the user will be better able to understand their common operating procedures as well as their interaction during emergency situations.

1.1 Background

The Naval Station Pier Sewer System was installed by the 1974 MILCON project to enable the base to comply with the Federal Water Quality Act of 1972 as specified in DOD Directive 6050.4. Details of the Navy's compliance are given in OPNAV Instruction 6240.3E for both the ship and shoreside responsibilities in ship wastewater collection and transfer.

The pier sewers are designed to collect shipboard generated wastewater from naval vessels. Surface vessels and small craft either collect and hold wastewater with installed Collection Holding and Transfer (CHT) systems or, on smaller vessels, with Marine Sanitation Devices (MSD) which provide some onboard processing. The majority of vessels using the pier sewers at the Naval Station will have CHT systems. These systems will be installed on nearly all Navy surface vessels by April, 1981. Properly equipped vessels are required to operate their systems prior to that date.

The operation of CHT systems with pier sewers has been well documented from field tests and extensive operating experience at other naval port complexes. The procedures outlined in this manual are field-proven from this rapidly growing base of prior experience as the number of activities accepting shipboard wastewater quickly increases.

General operating guidance for ship to shore sewage transfer hose connection, cleaning, and sanitation are documented in NAVFAC manual MO-340. Additional information and support is available from NAVFACLANTDIV Environmental Division and Public Works Utility Departments of other naval activities.

This manual briefly applies the recommendations in MO-340 specifically to the Norfolk Naval Station and is organized into the following sections:

2. FACILITIES AND EQUIPMENT DESCRIPTION. Discusses the general purpose, layout, characteristics of ship generated wastewater, and details of pier piping layout.

3. SHIP WASTEWATER CHARACTERISTICS. Presents information on the contents of ship generated waste.

4. SEWER CAPACITIES. Presents data for the expected loading capacity of the pier sewer system from maximum planned ship berthing arrangements.

5. SEWER PROCEDURES - NORMAL. Discusses the additional procedures to be followed when connecting or disconnecting ships to these pier sewers.

6. SEWER PROCEDURES - EMERGENCY. Presents the emergency procedures to be followed for specific emergency conditions and recommended repairs.

7. HEALTH AND SAFETY. Provides personnel health and safety precautions in working with sewer transfer equipment and its maintenance.

8. MAINTENANCE. Presents a daily and regular maintenance schedule for the pier sewer system.

2. FACILITIES AND EQUIPMENT DESCRIPTION

2.1 General

The collection and transportation of ship generated wastewater to shoreside treatment facilities involves several interrelated systems and activities. These are:

	SYSTEM	ACTIVITY
a.	The shipboard sewage Collection, Holding and Transfer (CHT) system.	Ship
b.	Ship to shore sewage transfer hose and fittings.	Ship/PWC
c.	Pier sewer installations.	PWC
d.	Sewage pumping stations.	PWC
e.	Sewage treatment plants.	HRSD

Figure 2-1 is schematic of the ship to shore wastewater transfer components. Wastewater is collected and held by the ship's CHT system and pumped to shore through sewage transfer hoses to the pier sewer. The wastewater flows by gravity from the piers to other larger buried sewer lines which are connect other pier sewers. The sewage from all piers in the system flows to a single wet well and pump station. The pump station periodically pumps the collected ship sewage through a pressurized force main to the HRSD Army sewage treatment plant. The treated water is then discharged into the receiving water at the plant's outfall.

2.2 Pier Sewers

The pier sewer system identified as piers 20, 21, 22, and 23 at the Norfolk Naval Station consists of 6,100 lineal feet of 10, 12, 15, 16, 18 inch

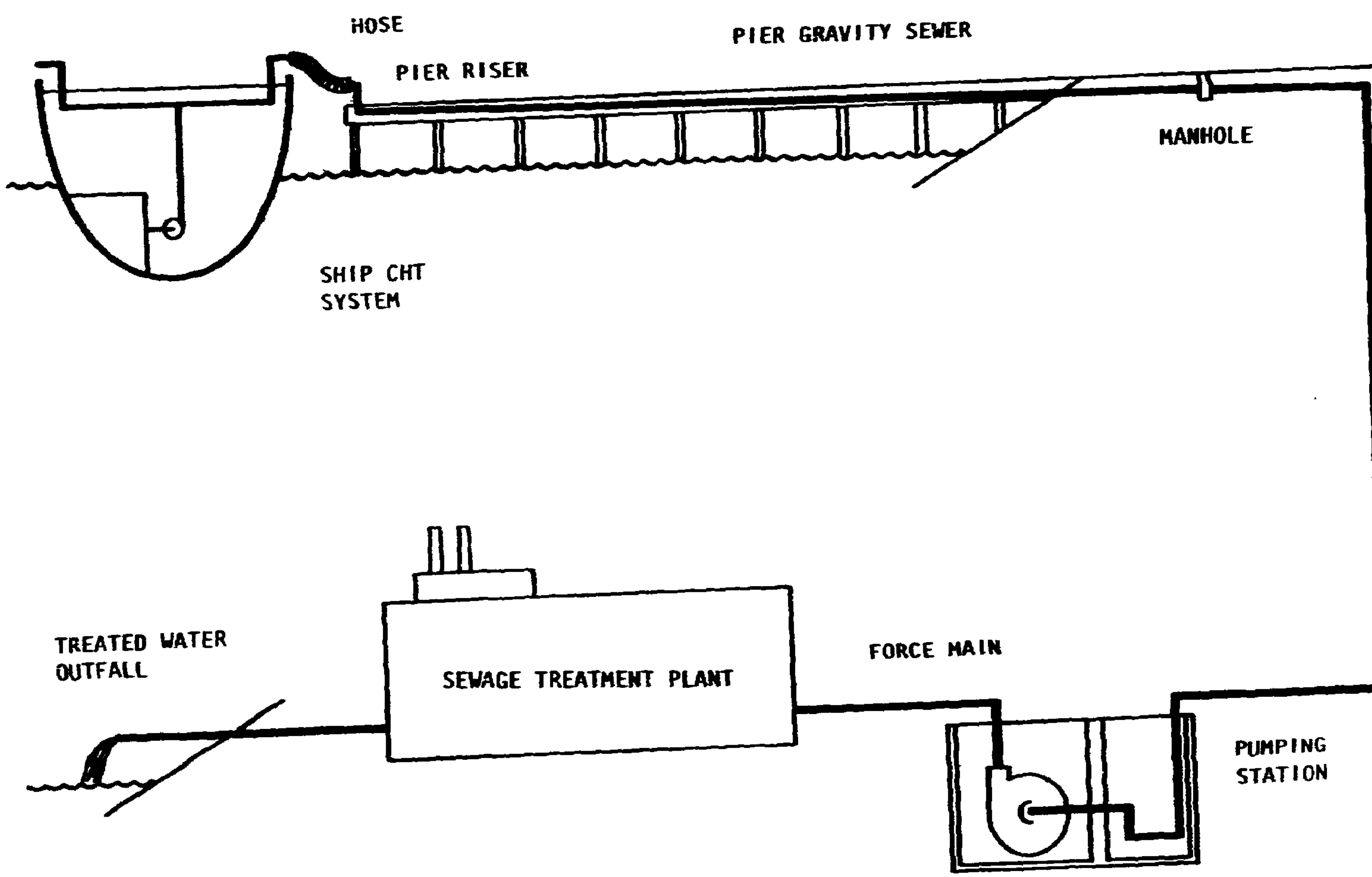


FIGURE 2-1. Sewer System Schematic

diameter ductile iron and viterous clay pipe, manufactured according to specifications as detailed in NAVFAC Design Manual (DM-5). The total full volume of the system including collectors and main conduit is approximately 38,000 gallons with individual section full capacity flow rates ranging from 404 gpm to 1,908 gpm. Full capacity velocities of the larger 18 inch diameter sewer pipe sections leading to pump station #3 are 2.3 fps. Velocities occurring in the suspended pier piping range from 1.7 to 1.8 fps.

The system is of the gravity sewer type consisting of sloped sections of 10 and 12 inch diameter pipe suspended below each pier and intersecting to lead to the pump station. Velocities throughout the system fall below the DM-5 minimum requirement of 2.5 fps.

Each pier has two discrete main sewer lines each consisting of 9 pairs of ship to shore hose connection points. Also, each pier is outfitted with clean-out access points to facilitate flushing of the pier systems.

Ship to pier connections are made with camlock fittings accessible through the new hose coupler manholes. This fitting is a vertical 4 inch female coupler which is extended above pier level by 4 inch elbow adapters. All coupler manholes are stamped "SEWAGE" on top and are hinged for access to the below deck 4 inch female fitting. Figures 2-2 through 2-6 depict the sewer layout including the details of the elbow adapters. Table 2-1 details the specifics of pipe, size, capacity, and velocity.

2.3 Pump Station

The pump station is located on "B" Avenue near pier #22. The station receives sewage through an 18 inch sanitary sewer leading from manhole #1 at the west side of the building. There are three centrifugal pumps with rated capacities as follows:

Pump #1 - 800 gpm

Pump #2 - 2,100 gpm

Pump #3 - 2,100 gpm

Pump #1 serves as the main duty pump for the system. Pumps #2 and #3 act as standby pumps to be activated when the sewage inflow exceeds the

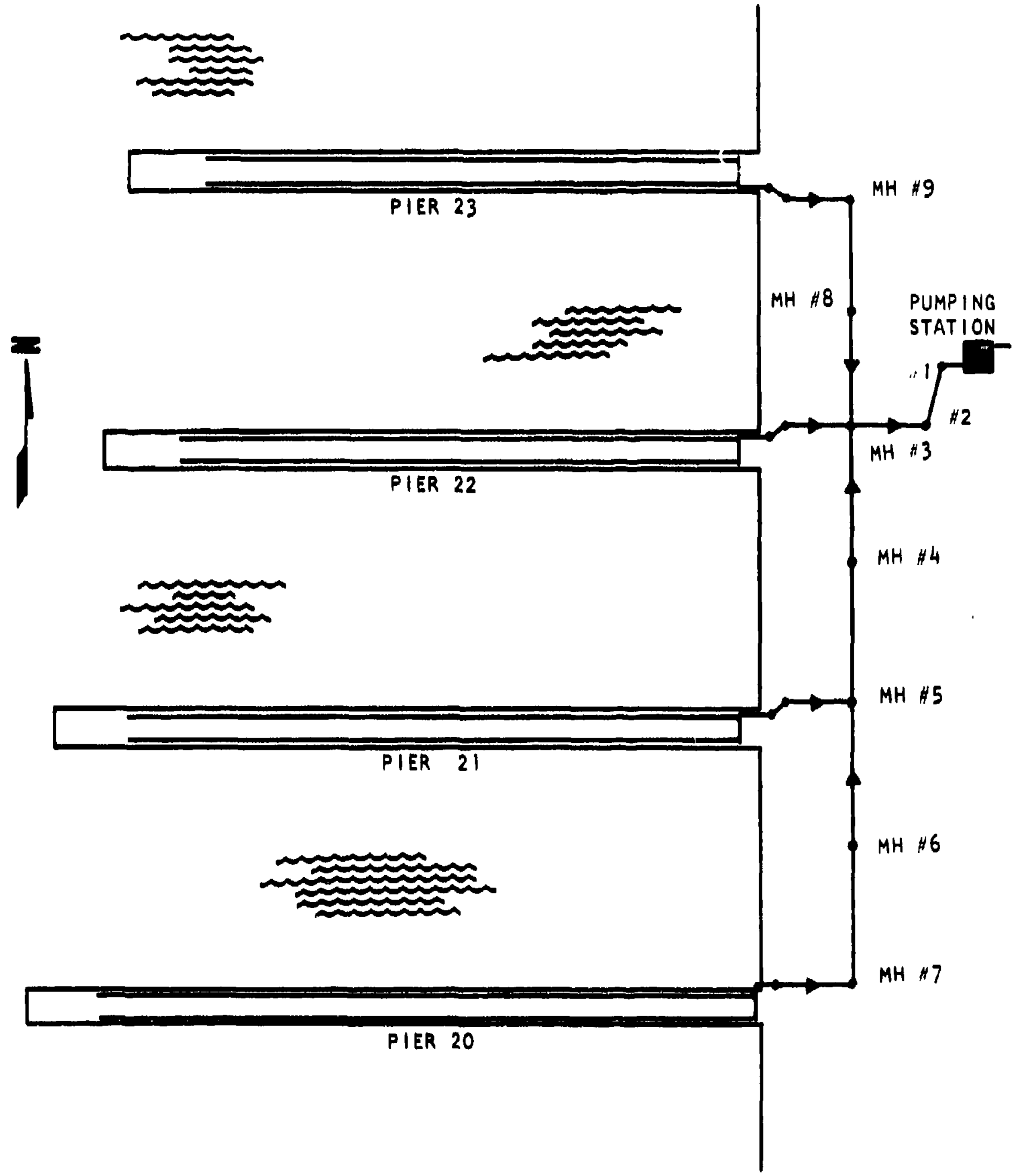


FIGURE 2-2. Receiving Sewer Layout

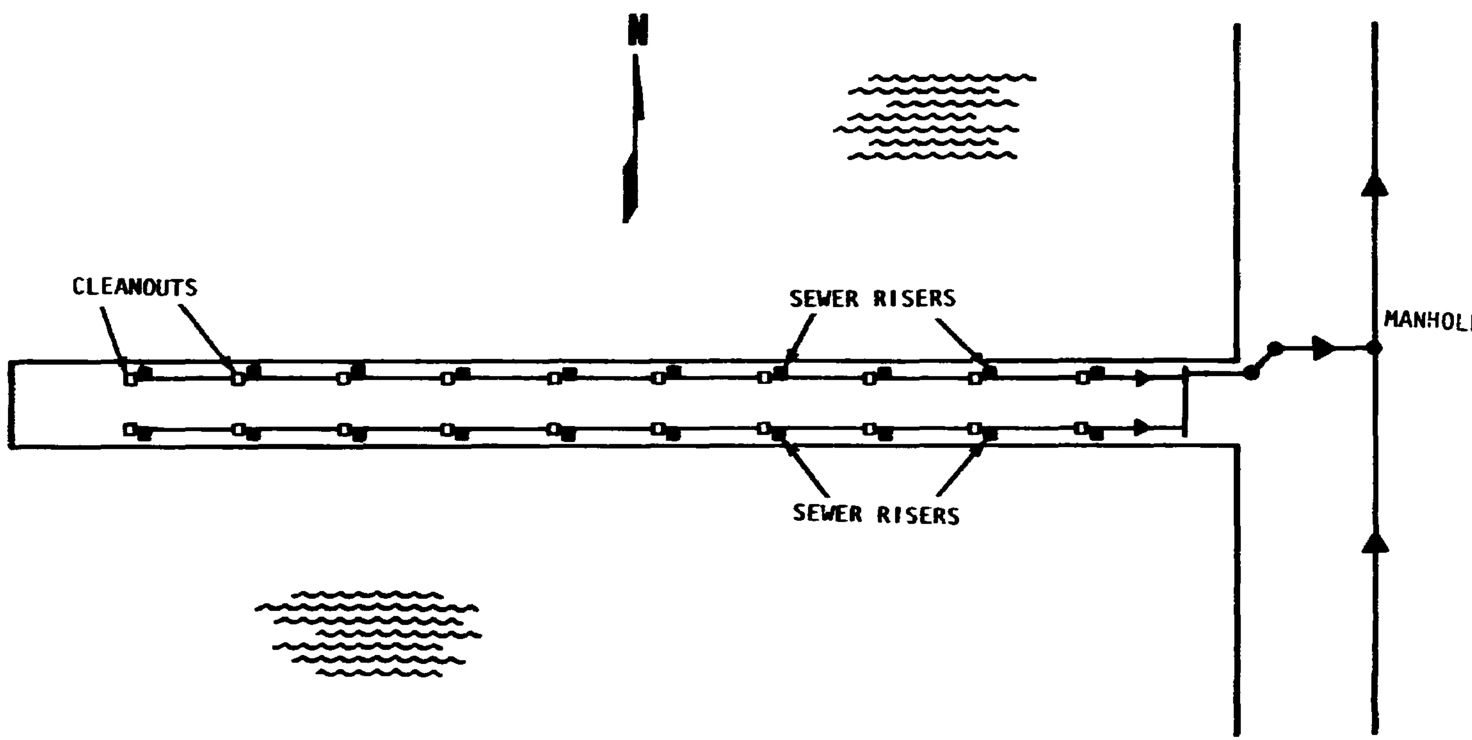


FIGURE 2-3. Pier Sewer Layout

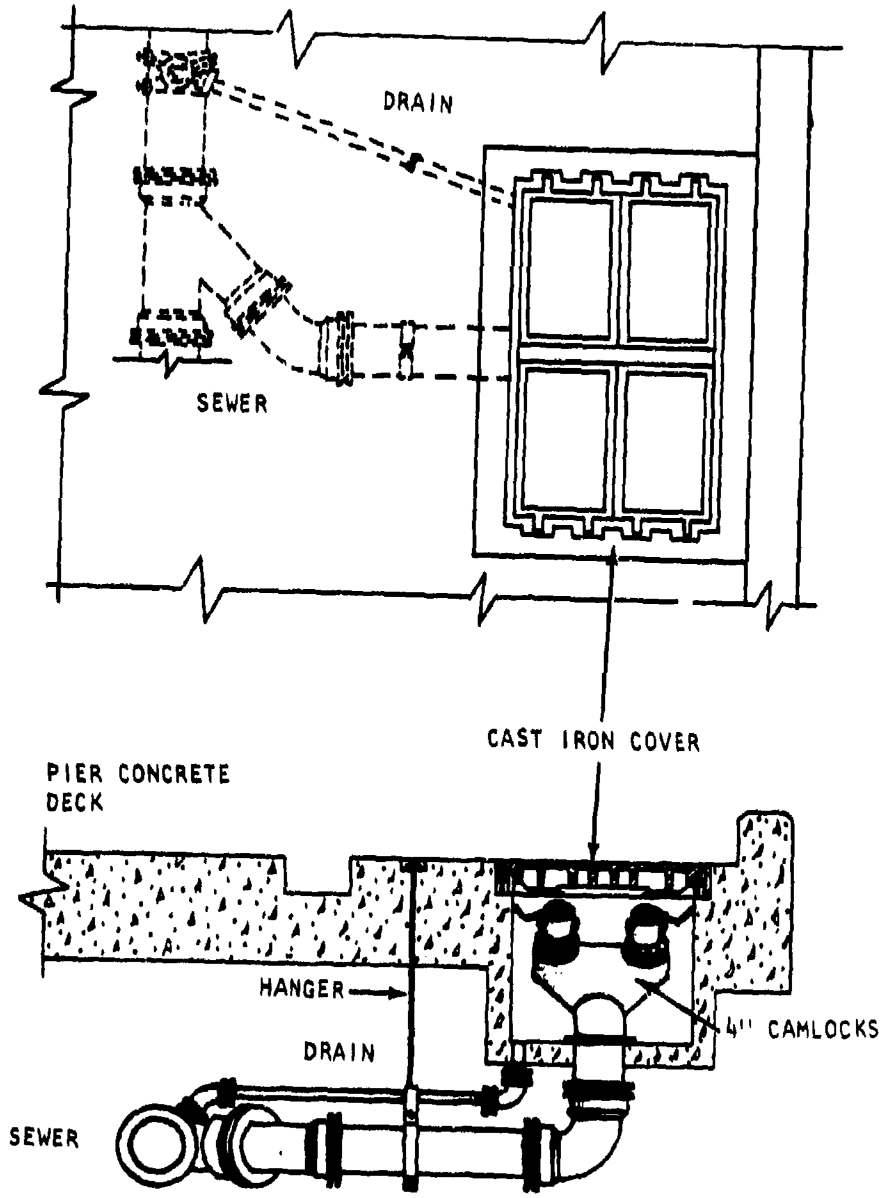


FIGURE 2-4. Pier Riser Details

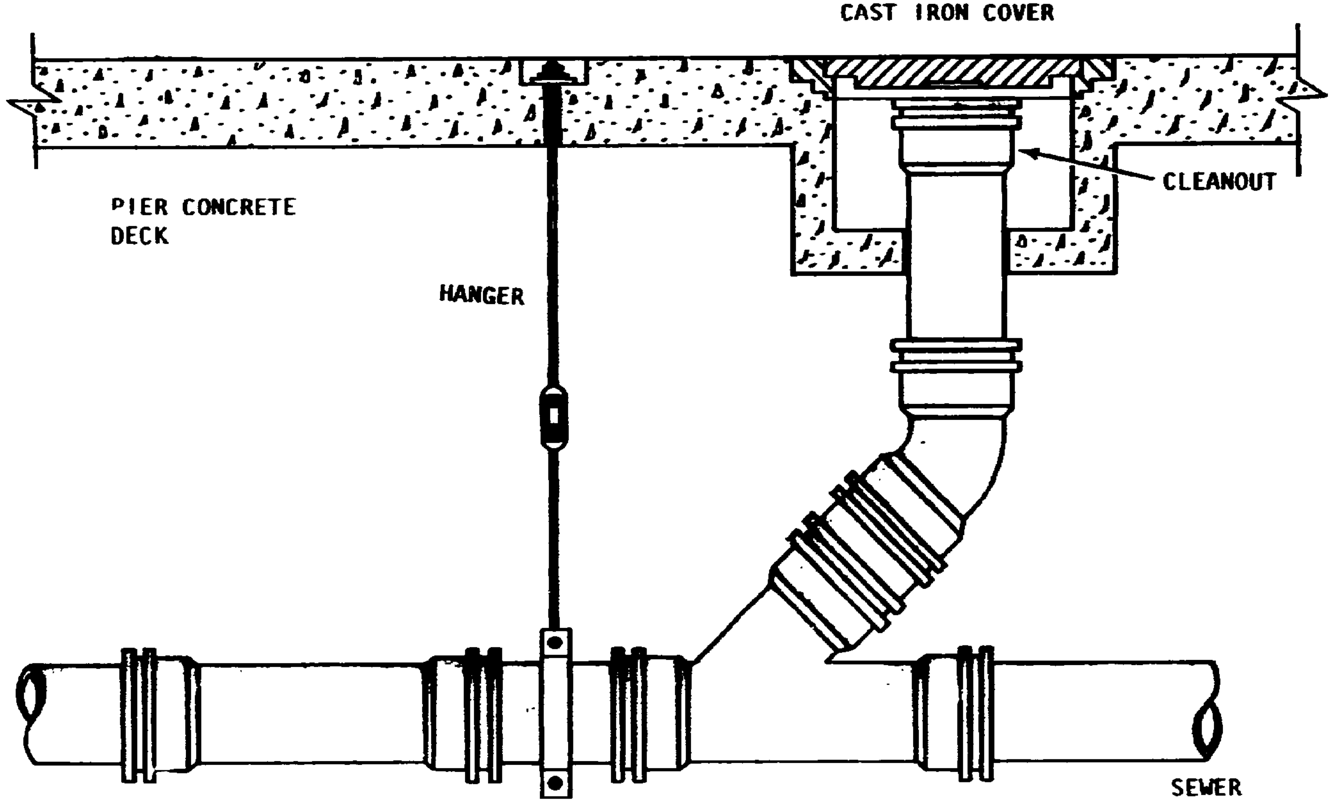


FIGURE 2-5. Cleanout/Sewer Detail

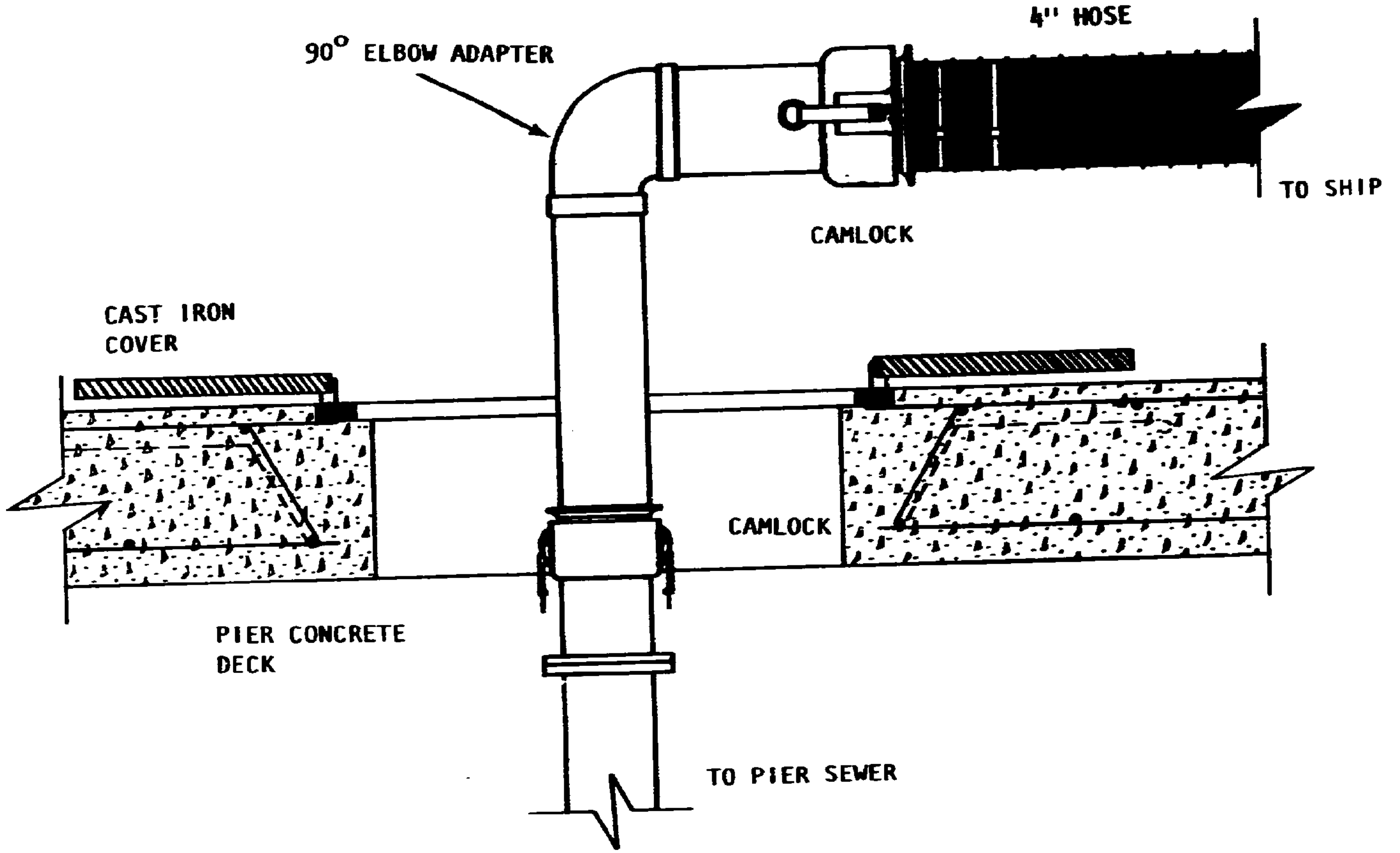


FIGURE 2-6. Hose Connection Cross Section

TABLE 2-1

NAVAL STATION NORFOLK, VIRGINIA

DETAILS OF WASTEWATER COLLECTION SYSTEM (PIERS 20-23)

Location	Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
*Pier 20 South	10	285	0.28	1172	404	1.7
	12	146	0.22	863	606	1.8
	12	151	0.25	892	651	1.8
North	10	285	0.28	1172	404	1.7
	12	146	0.22	863	606	1.8
	12	151	0.25	892	651	1.8
Lateral	12	15		89		
Lateral to MH 10	16	15		157		
MH 10 to MH 17	15	80	0.18	736	1032	1.9
Pier 21 South	10	303	0.28	1247	404	1.7
	12	129	0.22	762	606	1.8
	12	203	0.25	1200	651	1.8
North	10	303	0.28	1247	404	1.7
	12	129	0.22	762	606	1.8
	12	203	0.25	1200	551	1.8
Lateral	12	15		89		
Lateral to MH 12	16	20		209		
MH 12 to MH 11	16	18		188		

TABLE 2-1 (Continued)

NAVAL STATION NORFOLK, VIRGINIA

DETAILS OF WASTEWATER COLLECTION SYSTEM (PIERS 20-23)

Location		Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
MH 11 to MH 5		15	73	0.25	672	1212	2.2
MH 9 to MH 8		15	105	0.18	966	1032	1.9
MH 8 to MH 3		15	105	0.18	966	1032	1.9
**MH 3 to MH2		18	56	0.22	741	1908	2.3
**MH 2 to MH 1		18	86	0.22	1139	1908	2.3
**MH 1 to Pump Sta#3		18	18	0.22	238	1908	2.3
Pier 22	South	10	257	0.28	1056	404	1.7
		12	165	0.22	975	606	1.8
		12	182	0.25	1076	651	1.8
	North	10	257	0.28	1056	404	1.7
		12	165	0.22	975	606	1.8
		12	182	0.25	1076	651	1.8
	Lateral	12	15		89		
Lateral to MH 14		16	18		188		
MH 14 to MH 13		16	17		178		
MH 13 to MH 3		15	71	0.25	653	1212	2.2
Pier 23	South	10	296	0.28	1217	404	1.7
		12	92	0.22	544	606	1.8

TABLE 2-1 (Continued)

NAVAL STATION NORFOLK, VIRGINIA

DETAILS OF WASTEWATER COLLECTION SYSTEM (PIERS 20-23)

Location	Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
	12	184	0.25	1087	651	1.8
North	10	296	0.28	1217	404	1.7
	12	92	0.22	544	606	1.8
	12	184	0.25	1087	651	1.8
Lateral	12	15		89		
Lateral to MH 16	16	15		157		
MH 16 to MH 15	16	18		188		
MH 15 to MH 9	15	72	0.25	672	1212	2.2
MH 7 to MH 6	15	126	0.18	1159	1032	1.9
MH 6 to MH 5	15	124	0.18	1141	1032	1.9
MH 5 to MH 4	18	126	0.14	1668	1527	1.8
MH 4 to MH 3	18	122	0.14	1277	1527	1.8
		6099 ft.		37831 gal.		

*Each pier is fitted with 18 ship-shore collection manifolds with 2 4" camlock fittings and 19 cleanout stations.

**Maximum system flowrate and full flow velocity.

capacity of the pump #1. Incorporated within the system is a sluice gate and accompanying operator wheel to regulate the inflow of sewage to the wet well. Also, a standby generator is stationed so as to permit continuous operation in the event of power failure. The wet well area is vented by way of an 8 inch cast iron vent outletting to atmosphere. All pumps are mounted on concrete pedestals and equipped with outlet check and gate valves. In addition, a sump pump is situated below floor level and equipped to discharge into the adjacent wet well. Discharge from the three sewage pumps is conveyed through a 10 inch flow meter and then into a 10 inch force main and subsequently to the municipal treatment facility. The actual pumping head is approximately 15 feet. An access for service and maintenance on the pumps, piping and valves is by way of a stairway leading from the ground level motor room to the pump room below. Figure 2-7 is a cross section schematic of the pump station.

2.4 Hose Cleaning and Storage Building

The structure is located east of the pier area and has provisions for handling hose wash down and rack storage. The area is outfitted with wash racks and storage racks for collapsible sewage hose. For wash down purposes, main supply water outlets are available. Personnel lockers, showers, laundry facilities, and toilets are available along with office space.

2.5 List of Pertinent Plan Drawings

The following table lists key drawings of the pier side collection system:

TABLE 2-2 PERTINENT PLAN DRAWINGS

DESCRIPTION	EFD DWG. NO.	NAVFAC DWG. NO.
Location plan and list of drawings	110574	4010574
General plan	110575	4010575
Third Street, plan and profile	110577	4010577
B Avenue - Third Street to Station 18+00	110578	4010578

DESCRIPTION	EFD DWG. NO.	NAVFAC DWG. NO.
Pier 20, plan and profile	110583	4010583
Pier 21, plan and profile	110584	4010584
Pier 22, plan and profile	110585	4010585
Pier 23, plan and profile	110586	4010586
Pier details	110589	4010589
Ship to shore connection details	110591	4010591
Shore gravity sewer and force main details	110594	4010594
Pumping station #3, site plan and elevations	110601	4010601
Pumping station #3, floor plans	110602	4010602
Pumping stations #3, roof plan and sections	110603	4010603
Hose sanitation facility, general plan	110607	4010607

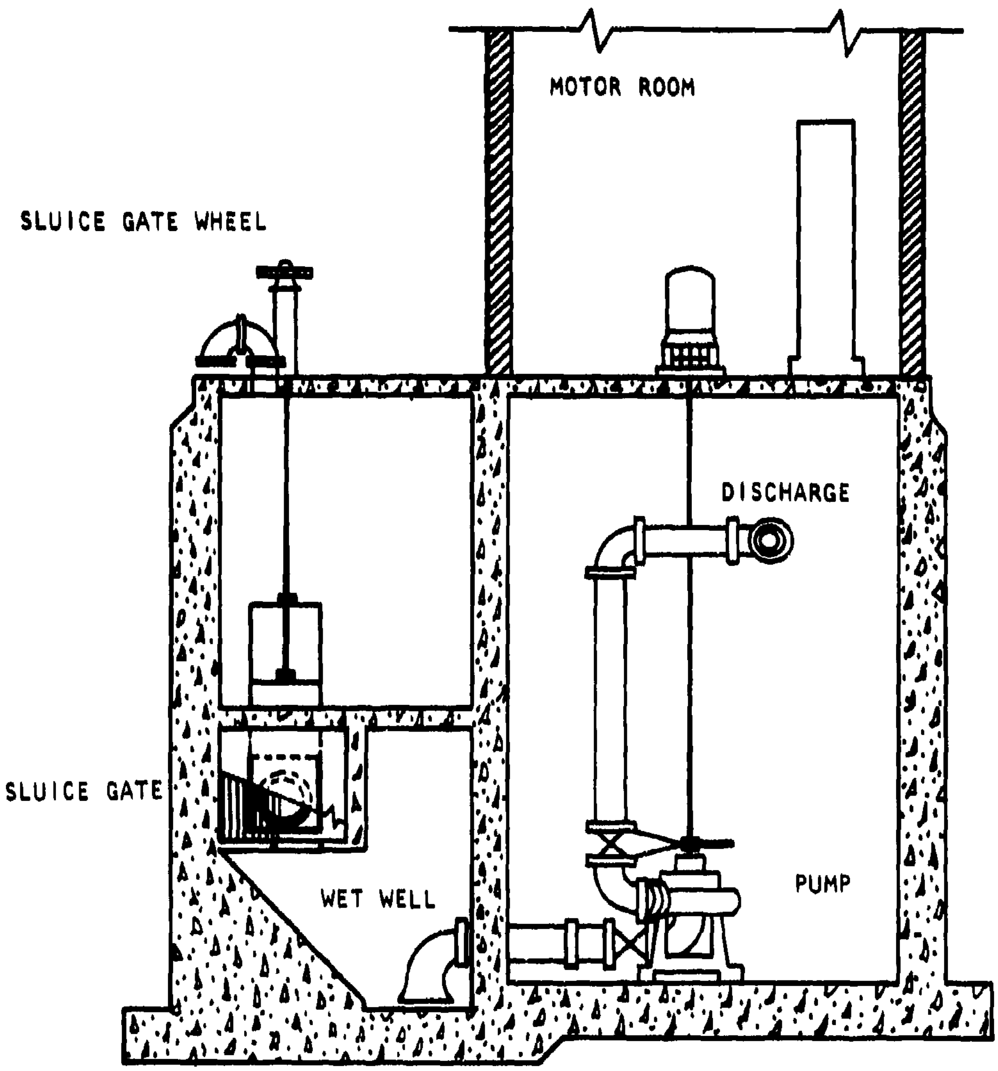


FIGURE 2-7. Pump Station

3. SHIP WASTEWATER CHARACTERISTICS

Flushing water for shipboard sanitary systems is provided by the salt water firemain supply. As a result, the primary difference of ship verses domestic sewage characteristics is the chloride level. Generally, studies have shown that ship generated wastewater settles well and can be treated by normal biological treatment processes. Table 3-1 presents the characteristics of ship sewage from NAVFAC Design Manual DM-5. Also included are the results of wastewater tests on USS Nimitz (CVN-68).

Most of the ships' CHT systems have garbage grinder discharges into the collection systems. These tend to increase the suspended solids, BOD, grit, primary sludge and scum.

The monitoring of volumes of ship generated waste have shown that in actual practice the daily volume may be several times greater than the design standard of 60 gallons per man per day. These high flows are generally the result of a constant saltwater flushing source into the CHT system. Usually the ship is unaware of this flushing.

SPRUANCE class destroyers have Jered vacuum collection systems. These systems collect and pump to shore a concentrated sewage of no more than 800 gallons per day.

TABLE 3-1

SHIP WASTEWATER CHARACTERISTICS

CHARACTERISTIC	DM-5 mg/l.	NIMITZ (CVN-68) mg/l. average
Total Suspended Solids	600	208
Total Dissolved Solids	20,000	--
Chlorides	11,000	6,883
Sulphates	1,500	--
Sodium	6,200	--
Other Dissolved Solids	1,300	--
BOD at 20^{o} C.	400	251

4. SEWER CAPACITIES

4.1 Ship Sewage Production

According to the berthing plan for fiscal year 1980 as detailed for pier operations at the Naval Station, piers 20 through 23 will accommodate a total of 33 ships. The most common ships, in terms of wastewater production, will be the destroyer type DDG. The total complement for ships' personnel expected with the berthing arrangement is 9,577 men.

Although NAVFAC design manual DM-5 calculates flow rates based on the 60 gpcd average, recent ship activations have shown waste generation rates to be more than 144 gpcd. For the purposes of estimating the maximum flow to the shore side collection system during the fiscal year 1980 planned berthing arrangement, the following section considers a generation rate of 144 gpcd. Tables 4-1 and 4-2 summarize the expected ship volumes and the flow rates derived from the expected berthing arrangement.

4.2 Expected Total Ship Loads

As shown in table 4-1, the average maximum 24 hour flow rate, at 144 gpcd for maximum berthing, is 958 gpm. This is derived from the number of ships expected to berth at these piers and their respective complements. At these highter rates, this would mean a total daily flow of 1,380,000 gallons of sewage from this pier system. At 60 gpcd, the total daily flow from these piers would be about 575,000 gallons.

Table 4-2 provides a comparison between the average 24 hour flow rate, the peak flow rate, and shore side system capacity. The peak flows shown are calculated based on 144 gpcd and are somewhat higher than the original design. Yet, even with the higher design estimates, individual pier sewers have capacities that are fairly close to the peak flow estimates. Only for the combined peak flows is the shore side capacity inadequate. What must be remembered about peak flow rate is that is occurs for a relatively short

TABLE 4-1

PLANNED BERTHING FY 1980

PIERS 20, 21, 22, 23

Location	No. Ships	Ship Type	Complement total	Avg. 24 Hr. Flow* gpm.
Pier 20	3	AO	1086	109
	1	AOR	436	44
Pier 21	5	DDG	1770	177
	5	DD	1450	145
Pier 22	10	SSN	1070	107
	1	AS	1075	108
Pier 23	5	SSN	535	54
	2	CGN	1080	108
	1	AS	1075	108
Totals	33		9577	958

*Based on field-determined production rate = 144 gal. per capita day (gpcd).

Peak flow = 386 gpm + 4 (958 gpm) = 4218 gpm where 386 gpm equals the highest design discharge from ship type AO.

TABLE 4-2

SUMMARY OF PLANNED BERTHING

ARRANGEMENT DISCHARGE TO SHORE SIDE

COLLECTION SYSTEM

Location	Avg. 24 hr. Flow gpm.	Peak Flow (DM-5) gpm.	Shore Side Capacity* gpm.
Pier 20	153	998	1032
Pier 21	322	1668	1212
Pier 22	215	1125	1212
Pier 23	270	1460	1212
All Piers	958	4218	1908

*For each pier: flowrate of pipe section to main sewers.
All piers: flowrate MH #1 to Pump Station.

duration of 3 to 5 minutes for any single ship pumping. During this short pumping cycle, about 400 gallons per ship is discharged into the sewer. The sewer piping must be filled up before the system exceeds full pipe capacities. The difference between the peak flow and shore side capacity is about 2,300 gpm. At this rate it would take approximately 16 minutes of peak flow pumping to fill up the piping system and pressurize all the sewer. Peak flows will not occur for this length of time.

5. SEWER PROCEDURES-NORMAL

5.1 Connecting Ships

The NAVFAC Ship-to-Shore Hose Handling Manual, MO-340, provides detailed tasks for ship to shore sewage connections for a variety of ships and circumstances. The following information provides additional guidance for making connections at the Norfolk Naval Station.

The first step in making a successful ship to shore sewer hookup is knowing the requirements of the ship for shore side supplied sewage transfer hose and fittings. A log book with pages similar to Figure 5-1 recording the requirements and pier use history for each ship should be developed and maintained as more and more ships begin using pier sewers. This log provides a ready reference to the hose handling crew to provide the proper length of sewage transfer hose and fittings for each ship request.

The shore side handling crew requires at least two men. It is the responsibility of the shore side crew to meet with the ship's CHT officer to insure that his men are available and understand how to make the ship connections. Generally, at least three men are required aboard ship for this task. The ship's crew is not expected to handle sewage equipment on the pier.

At the Norfolk Naval Station there are two hose reel trucks which reduce the amount of manual handling of sewage hose for each connection. These hose reel trucks are dispatched in a timely manner to permit the immediate hookup of sewage hose to ships arriving at berth. All necessary fittings are included aboard each hose reel truck. Knowledge of the power reel assembly is essential to insure that hose lengths do not become kinked or jammed in the process of extending hose lengths.

The following procedures will aid in efficient ship to shore connections:

a. Sufficient hose lengths are loaded aboard the hose reel truck at the

SHIP LOG SHEET

SHIP: ______________________________

DISCHARGE RISERS/SIDE: ______________________________

HOSE SIZE: ______________________________

EXPECTED GPD: ______________________________

DIRECT HOSE FLUSHING AVAILABLE: YES _____ NO _____

CONNECT DATE	BERTH	RISER NO.	HOSE LENGTH	DISCONNECT DATE	TOTAL PUMPING DAYS	REMARKS

FIGURE 5-1. Log Sheet

hose handling facility. In addition, necessary fittings are identified and placed on the storage area of the truck. The truck is dispatched to the berthing area and the pier risers to be used are identified. Sufficient hose lengths are paid out from the hose reel and connected to a heaving line for passing to the ship. The female end should be plugged at this time and the cap is recovered from the ship before the shore hose handling crew departs.

b. The pier sewer risers are located under hinged covers in the pier deck. The pier sewer is a continuous gravity system and does not run full and is, therefore, not pressurized. Connections at the Naval Station are of the multiple collector design, including two camlock connections at each riser assembly.

c. Because the pier riser fitting is set below the pier deck level, it is necessary to connect a 90° adapter fitting to the pier riser. This 4 inch camlock adapter fitting rises approximately 15 inches above the deck surface to connect with the ship sewage transfer hose and prevents kinking.

d. To minimize the chance of accidental sewage spill, the shore crew must insure that the hose connection to the pier sewer riser is completed prior to the ship deck riser connection. In most cases, the adapter riser should be turned so that the connection is paralled to the length of the pier. By connecting the hose in this way the chances of hose kinking are reduced.

e. The last task for the shore side hose handling crew is to arrange the hose along the pier to minimize hose kinking, contact with steam lines, and away from vehicular traffic. The hose should be examined for leaks as the ships begin pumping and if gaskets or hose sections then require replacement, procedures for hose flushing and draining as described in the following sections should be followed before making repairs.

f. Because the Naval Station has multiple collection riser assemblies, care should be exercised when accessing the second camlock fitting once the first fitting is accepting sewage. The procedure to be followed should be to temporarily close the ship deck riser while the connection to the second camlock fitting is made.

g. Vibration of camlock fittings during ship pumping can cause the locking ears to come loose. A safety band tied through the camlock rings will prevent this.

5.2 Disconnecting Ships

Detailed procedures for disconnecting sewage transfer hose from ships and other vessels is described in NAVFAC MO-340, chapter 8.

a. The shore side hose handling crew should check with the shipboard personnel to insure that disconnecting procedures are understood and coordinated. At this time, plugs for the 4 inch camlock hose should be provided to the shipboard crew. These will help prevent spills as the hose is lowered.

b. Ships have been instructed to flush the sewage transfer hose with saltwater from the firemain connection installed in their CHT discharge piping. This flushing of the hose for 10 minutes is all that is usually required to clean sewage transfer hose. The shore crew should check with the ship to be sure that this procedure has been accomplished. At this time some ships are unable to provide direct saltwater flushing and, as such, the shore crews should be aware if the hose has not been properly flushed.

c. After flushing, the ship disconnects from their deck riser and drains the hose by allowing it to vent through their open fitting. At this time the shore crew should raise the low spots of the hose to allow it to drain into the sewer. Only after all draining is accomplished is the hose plug installed on the open hose.

d. The hose is disconnected from the pier riser only after it has been lowered to the pier. Hose caps and plugs should be removed before the hose is coiled and placed on the hose reel. This will allow the hose to vent while being reeled onto the truck.

e. The pier riser adapter is removed when the sewage hose is disconnected and the sewer riser plugged when not in use.

f. After returning to the hose handling and storage facility, the shore side crew should inspect all fittings and hoses for damage and separate them for maintanance purposes. Properly flushed sewage hose can be immediately used for other ship connections without further cleaning or maintenance.

5.3 Small Craft

Pier sewers will accept sewage from small craft and Sewage SWOB barges. At this time there has been little experience with procedures for these craft. They will be developed and included in NAVFAC MO-340.

5.4 Sewage Transfer Hose

There are several types of sewage transfer hose available for large ships, submarines, and small craft. Large ships with CHT systems use standard 4 inch camlock fittings on 4 inch hoses. Submarines use a 2 1/2 sewage hose with camlocks fittings and small crafts use 1 1/2 inch camlock fitting which prevents its use in other utility services. The hose is clearly marked "SEWAGE".

Sewage transfer hose comes in two designs. Originally, all facilities were outfitted with the 4 inch collapsible hose 50 feet, 130 pounds, manufactured according to MILSPEC-H-20176. A rigid wall, wire reinforced gravity transfer hose is also available for new procurements under MILSPEC-H-20176D. Five years of continuous service life for all hoses should be expected.

The collapsible hose is suitable for all sewage transfer operations. However, the operator will note that it kinks easily and can shut off the flow from the ship. Additional care, then, must be taken to prevent hose kinking, particularly with rise and fall of the tide. Additional 90-degree elbows, temporary hose saddles, and tie-offs may be necessary. Ship hose connections should be regularly inspected by utility crews to insure that kinking has not occured.

As ships are pumping sewage, the collapsible hoses will pulse. This pulsing can quickly cause chafing of the hose and severe damage without proper precautions. This is particularly severe where the hose passes over concrete pier curbing.

6. SEWER PROCUDURES-EMERGENCY

As the pier sewer systems become a regular part of the utility services, these pier sewers must be kept operating with a minimum of service disruption in the event of system failure. This section provides some guidance as to some of the problems that may be encountered in repairing the pier sewer system and some methods to restore pier sewer service as quickly as possible with a minimum of disruption to shipboard operation.

6.1 Sewer Line Break

The pier sewer systems are interconnected to a common sewer main and pump station. This interdependence complicates the effect of a sewer line break or a major leak throughout the entire system. Breaks have already occurred on these piers. It should be noted that most of the pier sewer piping is submerged at high water, thus the greater cause of concern is the uncontrolled entry of seawater into the pier sewer system to the pumping station. The temporary isolation of broken pier sewers at the Naval Station has been accomplished by installing a ball-type rubber plug at the manhole intersecting to the shore side sewer system. This isolation served to be an effective means to continue operation of piers 20, 21, and 22. Also located at the Naval Station is a sluice gate at the inlet to the pump station. This device will also serve to isolate the pump station from a large intrusion of seawater as a result of a main break on any of the pier sewer lines. Figure 6-1 and 6-2 show examples of sewer plugs.

Pier sewer breaks may occur for the following reasons:

1. The under pier sewers are hung close to the pier fender piling and can be damaged from docking impacts.
2. Fender camels can become wedged under the pier sewer piping and crack the piping as they rise with the incoming tide.
3. Gradual saltwater corrosion can weaken sewer pipe flanges and

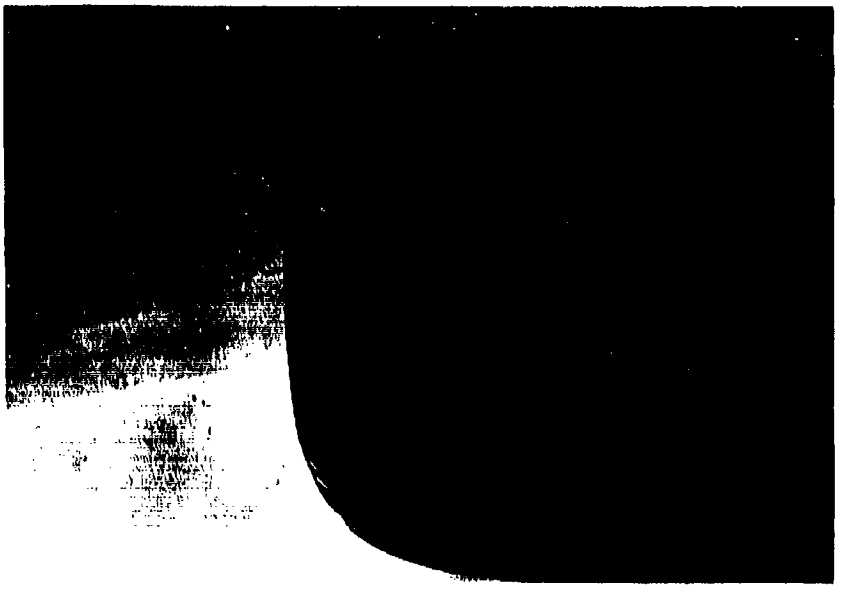


FIGURE 6-1. Air Inflatable Rubber Plug

FIGURE 6-2. Mechanical Screw Expandable Plug

expansion joints.

4. Seasonal ground settling can cause buried sewer line cracks, resulting in the infiltration of ground water. These cracks will not usually cause massive seawater intrusion but should be identified and repaired to limit unnecessary treatment plant processing charges.

If a major break occurs in the pier system it will be necessary to physically isolate that pier sewer from the rest of the system. The pier sewer line can be most effectively isolated with the use of a sewer plug as has been used on Pier #23 at the Naval Station.

A stock of these emergency repair type materials is available to a limited degree at the Naval Station. Additional materials should be purchased for ready use in the event of such sewer pier failures.

It may be necessary to delay the use of the sewer plug until a suitable tide level occurs. The safety procedures for manhole entry are discussed in section 7 and should be strictly followed for emergency repairs.

The below sequences should be followed by the Public Works Center utility division in dealing with a major break:

1. Upon notification of a pier sewer break, the ship up line of the break should be notified to secure sewage pumping. At the same time, port operations should be notified to provide sewage SWOB barges for the ship or alternative pier berths.

2. Notify the Hampton Roads Sanitation District (HRSD) of the possibility of increased saltwater content of the wastewater generated from Naval Base. This will provide the opportunity to monitor the wastewater and provide additional holding and mixing time.

3. Identify the appropriate manhole for sewer plug insertion. Prepare the necessary equipment for manhole entry and notify the safety department to provide a gas free certification of the manhole.

4. Determine the appropriate tide level and time from port operations when the sewer pipe may be accessible from the manhole.

5. Gather all necessary equipment for repairs and safety. Proceed to the selected manhole.

6. Install sewer plug.

After initial emergency plugging it may be possible to take some corrective action to provide a temporary fix for the broken pier piping. Small leaks and breaks may be repaired by the use of a mechanical pipe patch which is secured around the pipe diameter and tightened by any openended wrench.

The repair of broken pier sewer piping should be treated as an emergency and contracted accordingly. Sources of repair pipe and contractors with suitable equipment should be identified beforehand.

Sections of pier piping may be usable if the isolation plug is installed at the side of the pipe break. This will allow at least a portion of the pipe sewer to be used and additional sewage transfer hose can be provided to the ship so that it can pump to the nearest available sewer riser.

Waterfront operations should be kept informed of pier sewer repair conditions so that they may provide alternative berthing arrangements. Ships equipped with sewage transfer systems will be required to berth at piers with collection capability.

6.2 Industrial Waste Intrusion

Pier sewer systems have been used as a convenient but improper way to dispose of a variety of industrial waste from ships. These may include oil wastes, paint and paint thinners, boiler cleaning compounds, and a variety of shipboard hazardous materials. These wastes are usually first noticed in the pump station wet well and can be traced to their source via the pier sewer line. If intrusion is noted, action to remove the material must be taken. Also, HRSD should be immediately notified so that they can monitor their inffluent and take appropriate action to protect their treatment processes. At the Naval Station, facilities are available to provide pump-out of the wet well. If evidence of hazardous material exists in the sewers it must be flushed by a fire hose while collecting the material at the sanitary wet well.

Industrial waste material and flammable liquids enter the pier sewer piping only through the pier riser connections or directly into the manholes. Material spills into open areas that reach storm drains will not reach the pier sewer system. In most cases these drains discharge directly into the harbor. In the event of flammable material entering the sewer system, the Naval Station Fire Department should be notified and requested to inject aqueous film-forming foam (AFFF) into the pier sewer piping, manholes, or sanitary wet wells as necessary. AFFF is a toxic material and its use in sewers should be limited.

6.3 Electric Power Failure

The pump station is equipped with an emergency generator that is automatically activated as a result of base power failures. This emergency power will be provided sufficient pump power for the requirements of the shore side sewage collection system.

It is the usual practice of ships berthed at the Naval Station to use shore supplied power. In the event of shore side power failures, the ships will change to onboard emergency generators to provide partial ship power. It is the usual practice, however, that sufficient power will not be made available to its transfer system (CHT), therefore ships will not usually be pumping to the pier sewer system during base power failures.

If the pump station emergency power fails, ships connected to the system should be requested to begin holding or divert their systems until the power failure has been corrected. Failures of long duration will require sewage SWOB barges to be used to hold the ships' sewage.

6.4 Sewage Spill Procedures

Sewage spills occurring on open areas of piers most frequently occur from sewage hose failure, improper hose connection procedures, or vehicle damage to the pier riser fittings. The first concern in responding to a sewage spill is to keep personnel away from the area. Stop the source of the spill and flush down the area as quickly as possible. More detailed procedures are discussed in the following health and safety section.

6.5 Emergency Notifications

Any of the above emergency situations requires the notification of the following:

1.	Port Operations Duty Office	-2301
2.	PWC	-4431 day -3477 night
3.	Safety Department	-7351
4.	Hampton Roads Sanitation District Army Plant	423-7568

7. HEALTH AND SAFETY

The operation and maintenance of ship to shore transfer systems is no more hazardous than other waterfront operations. The safety and health precautions for this work require mostly a common sense approach. Historically, workers in the maintenance of sewer systems and the operations of treatment plants have enjoyed an excellent health and safety record. Workers with the ship to shore sewage transfer system should be aware of the following health and safety precautions.

7.1 Health Precautions

Clothing. The following list of clothing is suggested for most routine operation and maintenance procedures. Clothing should be washed frequently and a spare set of work clothes or coveralls available in a locker to provide a fresh change of clothing if necessary. No special segregation of this clothing is necessary for washing. It can be washed with regular home laundry.

Hardhat. An approved hardhat is required for all work pier side and this safety procedure should be carried over to the maintenance workers of the shore collection system.

Work Clothes. Regular work clothes or coveralls are all that is required for exterior clothing and working with sewage transfer hose. Coveralls and waterproof aprons are recommended when cleaning hoses or working with wet equipment.

Work Shoes. Steel-toed work shoes must be worn at all times when handling sewage transfer hose and fittings as well as performing maintenance tasks. Steel-toed rubber boots should be worn while making hose disconnects or when in wet sewage environments.

Washing Up. This is the most important category of health precaution to prevent unsanitary conditions. Workers must remember to wash hands and face after handling sewage equipment prior to eating, smoking, or drinking. This must become a regular habit of all sewage system workers. Hand washing and shower facilities are available in the hose cleaning and storage building.

Health Records. The base dispensary should be requested to mark the health records of personnel working with sewage transfer equipment with the following: "Occasional Contact With Raw Sewage".

Shot Records. BUMED has recommended that the normal series of innoculations be maintained for all personnel working with sewage equipment. These are tetnus, typhoid, and polio. Innoculations, if kept up to date, should provide a sufficient level of protection to the workers. Workers should be particularly careful with open cuts and must be sure to prevent infection by adequately cleaning any wounds. The dispensary should be visited for treatment any infections, sewage contact with eyes, or any abnormal health condition that may occur.

Potable Water Connections. Personnel working with sewage transfer equipment must not subsequently make potable water connections. If it is necessary to connect to a water hydrant to hose down an area of a sewage spill, a different worker should be called to make the connection and handle the fresh water hose.

7.2 Safety Precautions

Pier Operations. The shore crew for sewage transfer hose connections and disconnection procedures requires at least two men. While the hose at the Naval Station is supplied on a hose reel truck, two men are still advisable when handling the actual connection. Hardhats are necessary while on the piers, particularly when the hose is raised and lowered to the ship.

Manhole and Wet Well Entry. The following equipment is necessary for the safe entry into a sewer manhole or sanitary wet well.

1. Safety Barricade
2. Safety Harness and Life Lines
3. Ladder

4. Explosion Proof Lighting
5. Manhole Lifter
6. Portable Ventilating Blower

The instructions for entering and working in confined spaces such as sewer manholes are contained in Public Works Center Safety Instruction 5100.26. This instruction requires a gas-free permit to be issued by the Safety Department prior to entering a manhole or sanitary wet well. It should be remembered that the ladder rungs installed in manholes are particularly subject to corrosion because of the corrosive atmosphere of the saltwater sewage in these systems. These ladder rungs should be inspected for deterioration and tested with a hammer . If necessary, the manhole should be entered by a supplemental portable ladder if there is any question.

The presence of explosive and/or toxic gasses or an oxygen deficient atmosphere should be of constant concern to sewer maintenance workers. These gasses cannot be detected by smell and must be regularly tested by a proper sampling meter. If there is any doubt as to the condition of the atmosphere within a confined manhole, forced ventilation with a blower should be provided.

7.3 Sewage Spill Cleanup

Sewage spills are most likely to occur around the pier sewer connection riser and immediate pier deck area. These are usually the result of insufficient hose drainage prior to disconnection, leaking hose gaskets, hose rupture, or the action of a ship inadvertently pumping through a disconnected sewage hose. The basic procedure is to flush the area clean. The following procedure should be used and adapted for various sizes of sewage spills.

--Secure source of spill.

--Close off area to unnecessary traffic and personnel.

--Flush area with fire hose from hydrant or water truck (a separate non-contaminated man should be called in to make hydrant connection and handle the hose) - saltwater from a ship hose is preferred.

-- Use disinfectant or detergent to cut odor or grease if needed. (Use a dry phenolic compound or any stock detergent).

--Flush area again.

--Open area to regular activity.

The disinfectant recommended in MO-340 is germicidal, fungicidal concentrate (Phenolic dry type) stock 6040-00-753-4797. Chlorine (HTH) should not be used around piers or other areas where it may come in contact with grease or oil.

8. MAINTENANCE

The maintenance of pier sewer systems will become part of the regular maintenance program for the sewage system at the Naval Station. The design and installation of the pier sewer system is similar to that of domestic sewers. However, there are some differences and precautions to be noted in the maintenance of this system. The following sections highlight particular problems with pier sewer maintenance.

8.1 Regular Maintenance

The increased chloride level of ship generated waste will aggravate the effects of corrosion on the pier sewer system. More rapid deterioration will occur in the cast iron pipe sections, mechanical joints, and manhole ladders.

Regular daily inspections of the pier sewer system are important to insure continued trouble-free operation. The following daily inspections should be made:

a. Sewage transfer hoses from ships pumping into the piers' sewers should be inspected for tight camlock connections, leaks around gaskets and fittings, kinks in the collapsible hose, excessive weight from catenary bends, and contact with hot steam lines and hose chafing.

b. While ships are pumping into pier sewers, whenever possible, visual inspection of the exposed under pier collection lines should be made to observe for any damage or leakage. This inspection is best accomplished at low tide when all under pier piping will be exposed.

c. The pumping station wet well should be examined for evidence of oil or excessive grease buildup. If excessive oil or chemicals are present, pier sewer manholes should be examined to identify the source and isolate the same.

Less frequent inspections should be made at least weekly or as they occur in the following areas:

a. When no ships are using the pier system, a manhole should be inspected to determine the rate of any infiltration. This would be best accomplished during high tide at maximum submergence of the pier piping.

b. All underpier piping should be inspected for damage and evidence of leaking.

8.2 Regular Sewer Maintenance

The majority of the pier system piping at the Norfolk Naval Station has full pipe flow velocities less than the design standard established in NAVFAC DM-5 of 2.5 feet per second. As a result, these portions of the sewer system may quickly accumulate solids as a result of buildup due to the low flow rates of sewage. As the frequency of pier sewer use increases, at least quarterly inspections of these sections of the sewer system will be necessary to determine the rate of sludge buildup. Inspections of manholes should include observation for excessive oil, the evidence of sewer gas, infiltration, and pipe blockage. As solids buildup occurs line flushing and cleaning will be required. The Naval Station piers are equipped with cleanout access points adjacent to each ship to shore connection. Flushing and cleaning operations should be conducted from the most upstream portion of the system and stepped down to the pump station.

Extreme care should be taken during excessive cold weather periods which may cause line blockage from ice formation. It is the nature of CHT operation that the pier sewer is regularly doused with about 300 gallons of sewage from one ship pump firing. This dousing will occur infrequently, about once an hour, particularly during the coldest hours in the early morning. Since this flow is not constant and is of an intermittent nature loading may cause rapid ice buildup in the sewer lines. Until sufficient experience with cold weather operations in gained, extreme care should be taken to avoid the formation of ice. The pier piping should be inspected and maintained as necessary. Camlock gaskets found in the pier risers and hose require replacement about yearly to maintain a tight and leak-free connection.

8.3 Hose Maintenance

Regular maintenance procedures for sewer transfer hose are outlined in MO-340. Normal flushing of sewage hose with ship saltwater flushing connections will provide sufficient cleaning of the seage hose prior to disconnection. The most important maintenance function to be performed on the hose is routine inspection prior to hose storage. Evidence of leaks or excessive abrasion should indicate that individual hoses should be removed from service and bad sections removed by shortening the hose length, if possible. For hose in continuous service MO-340 recommends a hydrostatic pressure test to 100 psi at least every ninety days.

Additional hose cleaning is to be performed only when ship hose flushing is inadequate. The pier utility crews should encourage each ship to properly flush the hose. Several ships do not have direct flushing capability yet. These ships should be identified so that additional cleaning of those hoses will be performed.

SHIP WASTEWATER COLLECTION SYSTEM

STANDARD OPERATING PROCEDURES

FOR

DRYDOCKS 3, 4, and 8

NORFOLK NAVAL SHIPYARD

PORTSMOUTH, VIRGINIA

TABLE OF CONTENTS

Norfolk Naval Shipyard

Portsmouth, Virginia

LIST OF FIGURES

1. INTRODUCTION

This manual contains standardized operating procedures for use with the sewage collection systems installed on drydocks 3, 4, and 8 at Norfolk Naval Shipyard, Portsmouth, Virginia. These sewers collect sewage from ships while in the drydocks. This manual also contains useful reference information as to capacities and designed characteristics of these sewers.

The sewers installed on the piers at the shipyard are similar in construction and operating procedures as those described in the procedure manuals for the Naval Amphibious Base and Norfolk Naval Station.

In using this manual, it is hoped that those working with the systems will better understand their operating peculiarities so that better utility service can be provided to ships while in drydock.

1.1 Background

The Norfolk Naval Shipyard, Portsmouth drydock alterations for the sewer system was installed by a 1974 MILCON project. These sewers are designed to collect shipboard generated wastewater pumped ashore by Collection Holding and Transfer (CHT) Systems and other Marine Sanitation Devices (MSD). These systems are the result of the Federal Water Quality Act of 1972 and DOD Directive 6050.4. The Navy has complied with this directive through OPNAV Instruction 6240.3E and the installation of shipboard systems and shore side sewers.

The sewers are designed to collect wastewater primary from CHT systems, as these will be installed on the majority of the vessels in the drydock. Other systems on larger vessels include Jered vaccumn collection systems which discharge a more concentrated lower volume effluent. All Navy vessels will have installed systems by 1981. Properly equipped vessels are required to operate their systems prior to that date.

The operation of CHT systems with pier sewers has been well documented from field tests and extensive operating experience at other Navy port complexes. The procedures outlined in this manual are well proven from this field experience. General operating guidance for ship to shore sewage transfer hose connections, cleaning, and sanitation are documented in NAVFAC manual MO-340. Additional information and support is available from NAVFACLANTDIV Environmental Division and public works departments of other Navy activities.

This manual expands on the recommendations in MO-340 as they apply to the Norfolk Naval Shipyard and is organized into the following chapters:

2. FACILITIES AND EQUIPMENT DESCRIPTION. Discusses the general purpose of the system and the details of the drydock sewer system.
3. SHIP WASTEWATER CHARACTERISTICS. Presents information on the contents of ship generated wastewater expected to be discharged at the shipyard.
4. SEWER CAPACITIES. Presents data on the expected loading of the sewers and the calculated capacity of the systems for a maximum planned docking arrangement.
5. SEWER PROCEDURES - NORMAL. Discusses additional procedures to be followed when connecting or disconnecting ships to the sewers.
6. SEWER PROCEDURES - EMERGENCY. Presents the emergency procedures to be followed for emergency conditions and repairs.
7. HEALTH AND SAFETY. Provides personal health and safety precautions for working with sewer transfer equipment.
8. MAINTENANCE. Recommends daily and regular maintenance for the sewer system.

2. FACILITIES AND EQUIPMENT DESCRIPTION

2.1 General

The collection and transportation of ship generated wastewater to the shoreside treatment facility involves several interrelated systems and activities. These are:

SYSTEM	ACTIVITY
a. Shipboard sewage Collection, Holding and Transfer (CHT) system or MSD.	Ship
b. Ship to shore sewage transfer hose and fittings, and ship connections.	Shop 99
c. Pier sewer installations.	PWD
d. Sewage pumping station.	PWD
e. Sewage Treatment Plant.	City of Portsmouth

Figure 2-1 is schematic of a ship to shore wastewater transfer system. Ship wastewater is collected and held by the ships' CHT system and pumped to shore through the sewage transfer hose to the pier sewer. The wastewater flows by gravity from the piers or drydock sewers to other larger buried sewer lines. These larger sewers at the shipyard join other sewers from shops and other sanitary drains on the Naval Shipyard. These flow to a common pumping station which periodically pumps the collected sewage through a pressurized force main to the City of Portsmouth Sewage Treatment Plant. The treated water is then discharged from the plant at the plant's outfall pipe.

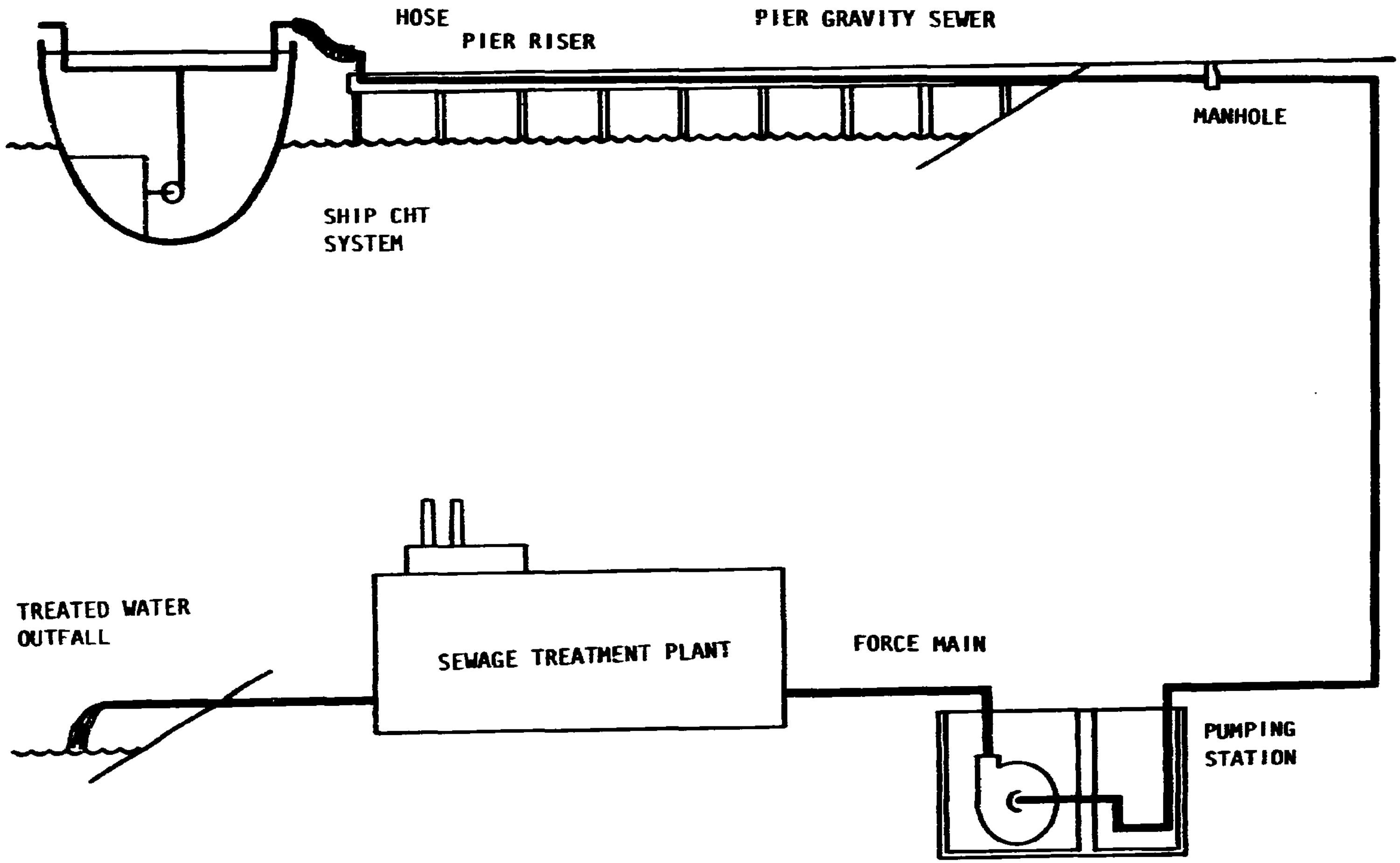


FIGURE 2-1. Sewer System Schematic

2.2 Drydock Sewers

The sewer system related to the drydocks 3, 4, and 8 on the Shipyard consist of 5,137 lineal feet of 6, 8, 10, 12, and 15 inch diameter ductal iron and viterous clay pipe. The total full volume of the entire drydock system including the collectors and main sewers to the existing collection lines is approximately 21,332 gallons, with individual pipe full flow rates ranging from 1,257 to 305 gallons per minute. The flow rates of the larger 15 inch piping are about 1100 gallons per minute at velocities about 2.0 feet per second. Table 2-1 gives the details of pipe size, capacity, and velocity. The minimum velocities of drydock 3 piping is 1.9 feet per second. The collection piping of drydock 8 is a force main with intermitent salt water purge which is automatically controlled.

It should be noted from this table that many of the section velocities are below the DM-5 minimum velocity requirements of 2.5 feet per second. This velocity requirement was intended to minimize the solids deposition which cause sewer sludge buildup and possible line blockage.

The collection piping along drydock 3 and 4 is equipped with vents to facilitate gravity draining and cleanouts to provide access for flushing and cleaning equipment if necessary.

Connection points are installed along the piping of each drydock. Ship to sewer connections are made with standard 4 inch camlock fittings. The camlock fitting is exclusive to sewage transfer hose on shipboard installations to lessen the possibility of a utility cross connection. As originally installed, many of these camlock fittings on the sewers were inaccessable for normal utility connection. These sewer risers are being changed by the addition of new piping or turning piping elbows. Figures 2-2 through 2-6 show details of the sewer layout including those of the connection fittings and the riser piping changes.

The drydock sewers and adjacent pier sewers join to common sanitary sewer pipes that collect from all industrial buildings and adjacent domestic sanitary drains on the Norfolk Naval Shipyard. These flow together to the Green Street Gate pumping station through a continuous gravity drain. From the Green Street pumping station, a force main discharges to the City of Portsmouth municipal system.

The pumping station provides the only wet well for temporary holding

TABLE 2-1
NAVAL SHIPYARD NORFOLK, VIRGINIA
DETAILS OF WASTEWATER COLLECTION SYSTEM
(DRYDOCKS 3, 4, 8)

Location	Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
MH 16 to MH 15	15	34	0.14	313	943	1.8
MH 15 to Existing MH	15	164	0.13	1509	898	1.7
MH 16 to Drydock 3*	8	54	0.40	141	305	1.9
Drydock 3 North	8	681	0.40	1784	305	1.9
Drydock 3 South	8	609	0.40	1596	305	1.9
MH 16 to MH 17	15	114	0.17	1049	1032	1.9
MH 17 to MH 18	15	186	0.19	1711	1122	2.0
MH 18 to Drydock 4**	10	99	0.45	407	583	2.4
MH 19 to Drydock 4	8	61	0.48	160	314	2.1
MH 16 to MH 19	8	118	0.42	309	314	2.0
Drydock 4 Northwest	8	109	0.40	286	305	1.9
Drydock 4 Northeast	8	161	0.40	422	305	1.9
Drydock 4 Northeast	10	334	0.22	1373	404	1.7
Drydock 4 Southwest	8	109	0.40	286	305	1.9
Drydock 4 Southeast	10	488	0.30	2006	449	1.9
MH 21 to Drydock 4	8	66	2.15	173	-	-
MH 22 to Drydock 4	10	64	2.05	263	-	-
MH 22 to MH 21	12	175	0.20	1034	628	1.8
MH 21 to MH 20	15	42	0.14	386	943	1.8

- continued -

TABLE 2-1 Continued

Location	Pipe Outside Diameter in.	Length ft.	Slope %	Volume gal.	Full Volume Flowrate gpm	Velocity fps
MH 20 to Existing MH	15	163	0.24	1500	1257	2.3
Drydock 8 (Each Side)***	6 FM	158		232		
	8 FM	220		577		
	10 FM	572		2351		
Drydock 8 West	10 FM	170		699		
Drydock 8 to Existing Sewer	10 FM	186		765		
Total		5,137		21,332		

*Drydock 3 - 16 sets of 2 ship to shore connections; cleanouts and vents also installed.

**Drydock 4 - 22 sets of 2 ship to shore connections.

***Drydock 8 - Force main pressurized by 175 PSI 12 inch saltwater main through flow rate controller and pressure reducing valve set for 900 gpm; all ship to shore connections (26 pair) isolated by gate and check valves.

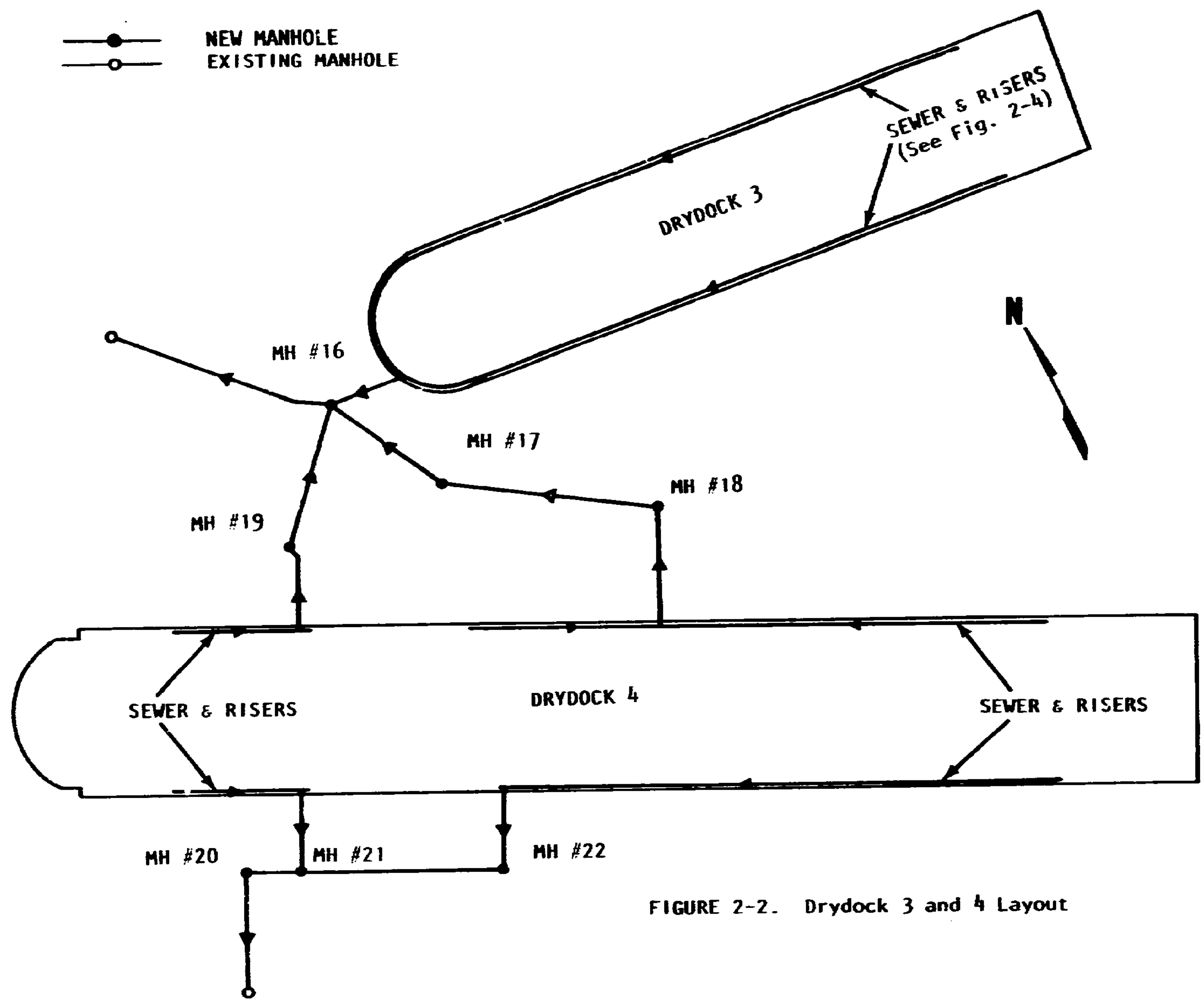


FIGURE 2-2. Drydock 3 and 4 Layout

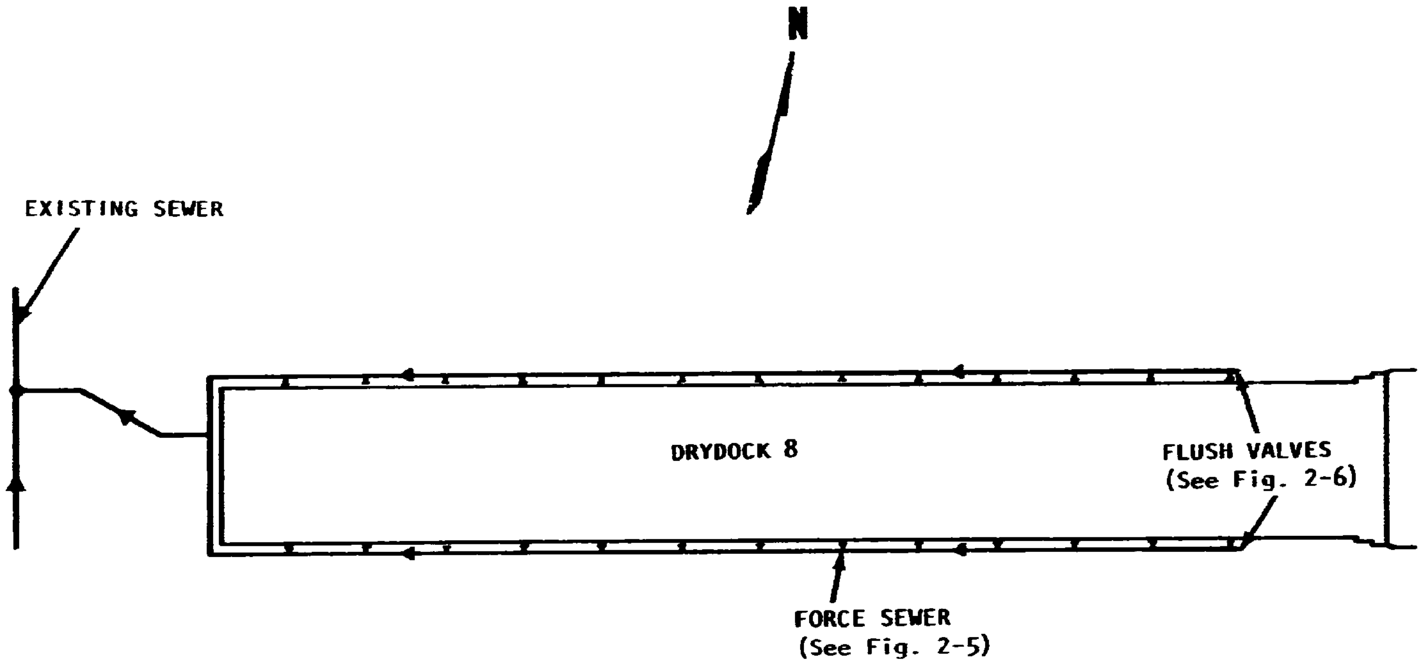


FIGURE 2-3. Drydock 8 Layout

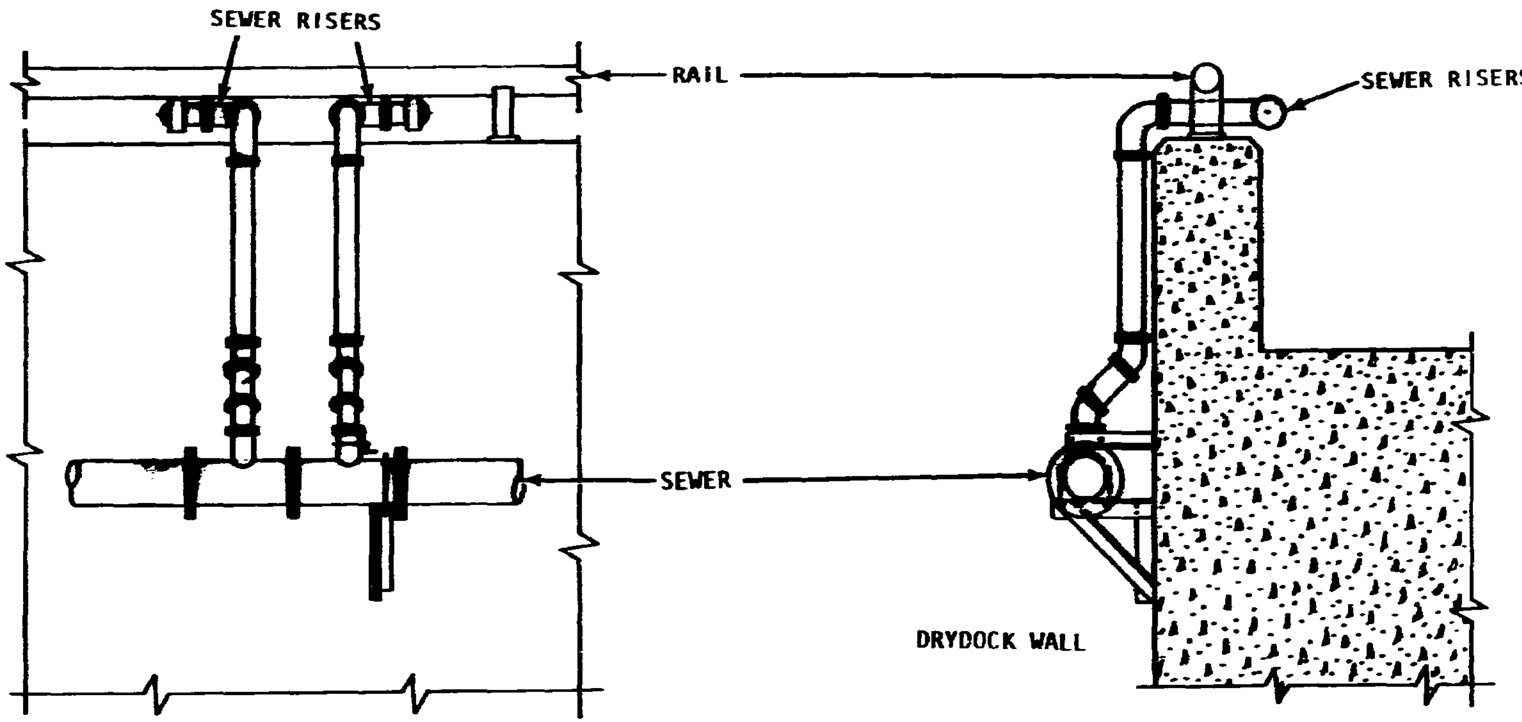


FIGURE 2-4. Riser Extensions Drydock 3

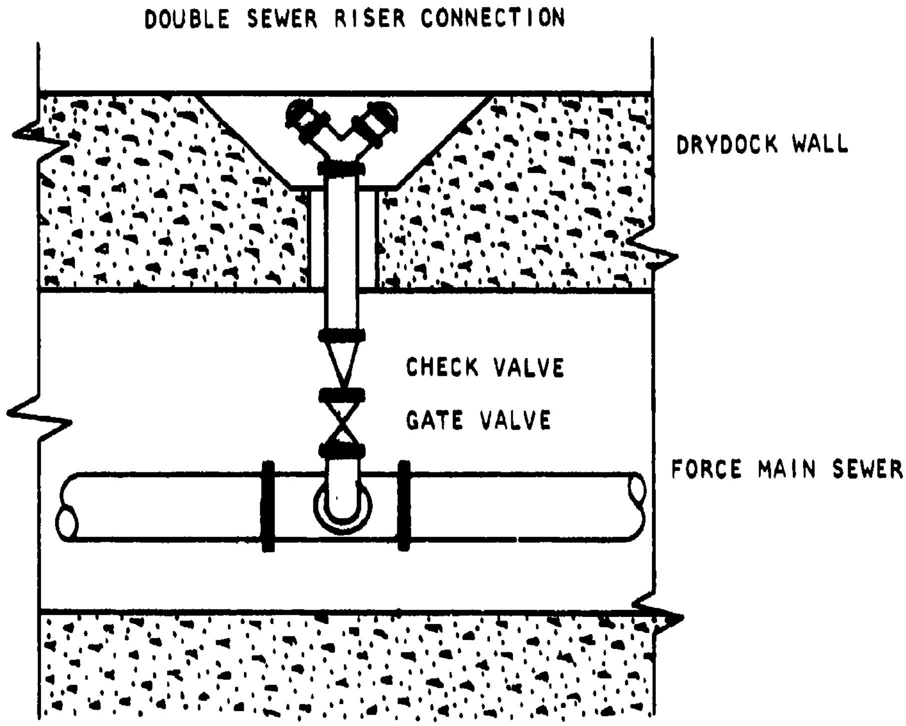


FIGURE 2-5. Drydock 8 Riser Detail

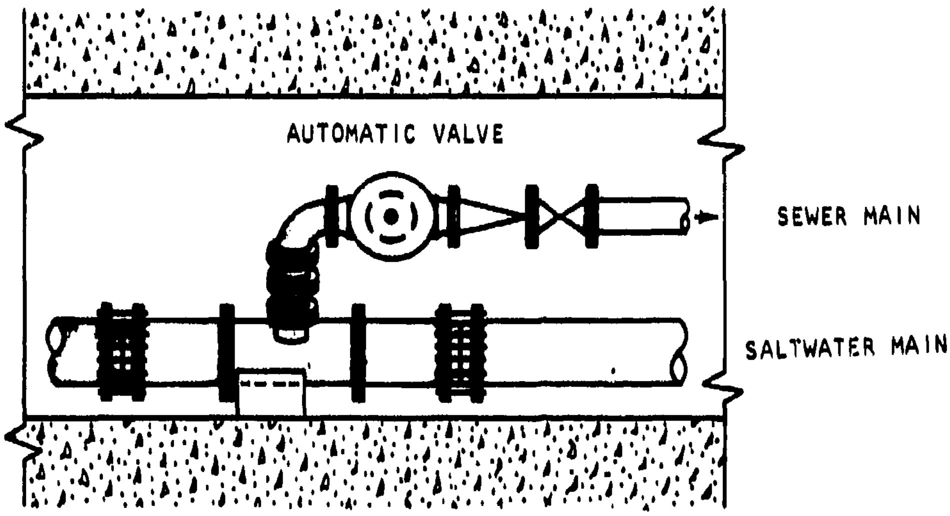


FIGURE 2-6. Drydock 8 Flushing System

of collected sewage waste. Also, at the pumping station is the only sewage meter to measure combined ship and other shoreside flows.

2.3 Hose Cleaning and Storage Building

A steel building is located near Gate 29 near Building 260 to provide additional hose cleaning, maintanence, and storage. The building is outfitted with wash racks for cleaning and hydrostatic testing of sewage hose, lockers, and office facilities for shop 99 personnel. Additional improvements to this building and area are being planned.

2.4 List of Pertinent Plan Drawings

Table 2-2 provides a list of reference plan drawings of the drydock system.

TABLE 2-2

PERTINENT PLAN DRAWINGS

DESCRIPTION	EFD DWG. NUMBER	NAVFAC DWG. NUMBER
Location map and list of drawings	113245	4013245
Site Plan - Drydock 3	113253	4013253
Site Plan - Drydock 4	113254	4013254
Sewer Profiles - Drydock 4	113255	4013255
Profile & Section - Drydock 4	113256	4013256
Profile & Section - Drydock 4	113257	4013257
Site Plan - Drydock 8	113258	4013258
Standard Details	113259	4013259
Plan & Details - Pier C	113261	4013261
Details - Pier C	113262	4013262
Profile & Elevation - Drydock 3	113263	4013263
Profile & Elevation - Drydock 4	113264	4013264
Details - Drydock 3	113265	4013265
Piping Plan - Drydock 4	113266	4013266
Profile & Elevation - Drydock 4	113267	4013276
Profile & Elevation - Drydock 4	113268	4013268
Details - Drydock 4	113269	4013269
Details - Drydock 4	113260	4013270
Details - Drydock 4	113271	4013271
Piping Plan - Drydock 8	113272	4013272
Piping Plan - Drydock 8	113273	4013273
Details - Drydock 8	113274	4013274
Details - Drydock 8	113275	4013275

3. SHIP WASTEWATER CHARACTERISTICS

The characteristics of shipboard generated sewage are somewhat different than those of regular domestic sewage. Since the majority of flushing water for shipboard systems is salt water, the primary difference of this sewage is the significantly increased chloride level. In general, extensive studies have shown that ship generated wastewater settles well and can be treated by normal biological treatment processes without adverse effects to these systems. The main problem in treating high chloride level sewage is to avoid sudden shock loading of the treatment plant biological systems. The sewage system at Norfolk Naval Shipyard provides an ideal system of diluting the ships' sewage with normal fresh water sewage from domestic sources. This dilution greatly lowers the chloride levels prior to sewage arrival at the Portsmouth Sewage Treatment Plant. Table 3-1 gives the characteristics of ship sewage from NAVFAC Design Manual DM-5. Also for comparison are the results of analysis of wastewater from the U.S.S. Nimitz (CVN-68).

Most of the ship CHT systems have garbage grinders which discharge directly into the sanitary collection systems. These will increase suspended solids, BOD, grit, and grease in the ship sewage.

Field monitoring of waste water volumes generated from ships have shown that in actual practice the daily volumes are several times greater than the DM-5 design standard of 60 gallons per man per day (gpcd). These higher daily rates (144 gpcd) are generally the results of constant salt water flushing into the CHT system. The characteristics of ship wastewater and volumes received will vary according to the number of men aboard while ships are in drydock. Limited flow should be expected when ships crews are not living aboard.

TABLE 3-1
SHIP WASTEWATER CHARACTERISTICS

CHARACTERISTIC	DM-5 mg/l	NIMITZ (CVN-68) mg/l average
Total Suspended Solids	600	208
Total Dissolved Solids	20,000	---
Chlorides	11,000	6,883
Sulphates	1,500	---
Sodium	6,200	---
Other Dissolved Solids	1.300	---
BOD at 20^{o} C.	400	251

4. SEWER CAPACITIES

4.1 Ship Sewage Production

For the calculation of ship sewage load, it will be assumed that, as shown in table 4-1, the drydocks contain 2 large cruisers and 1 large carrier. This arrangement gives us a total complement of 6,914 men. The calculations also will assume that the entire complement remains aboard while in drydock. The design calculations used for maximum 24 hour flow rates and peak flow rates are from NAVFAC Design Manual DM-5. The design manual uses a daily per capita average of 60 gpcd. However, field testing has shown the average closer to 144 gpcd. From the calculations, it can be seen that the larger number significantly effects the maximum and peak flow rates.

These three ships, with a total complement of 6,914 men, produce an average 24 hour flow rate of 692 gallons per minute at 144 gallons per capita day. The average 24 hour flow at 60 gpcd is only 288 gpm.

4.2 Expected Total Ship Loads

The sewer loading flow rates based on the docking situation described above are summarized in table 4-2. This table shows a comparison between the design standards and the field measured sewage generation rates. The maximum 24 hour flow rates calculated according to DM-5 are a function only of ships complement, and the per capita generated volumes. Although the water use habits of a ship in drydock may be significantly altered from normal pierside volumes, it should be expected that the maximum 24 hour flow rate will be greater then the design standard.

The peak flow rate is a function of the maximum pump discharge rate and the maximum 24 hour flow rate for the multiple dockings of ships. For single ships, according to DM-5, peak flow rates are a function of the design discharge pump flow rate. What must be remembered about peak flow rate is that it occurs for a relatively short duration of 3 to 5 minutes. During this short

TABLE 4-1
PLANNED BERTHING
DRYDOCKS 3, 4, 8

LOCATION	NO-SHIPS	SHIP TYPE	COMPLEMENT	AVERAGE 24 HOUR FLOW GPM @ 60 gpcd	@ 144 gpcd
Drydock 3	1	CG	1207	50	121
Drydock 4	1	CG	1207	50	121
Drydock 8	1	CV	4500	188	450
		Total	6914	288	692

TABLE 4-2

SUMMARY OF PLANNED BERTHING DISCHARGE TO SYSTEM

LOCATION	MAXIMUM 24 HOUR FLOWRATE GPM		PEAK FLOW GPM		SHORE SIDE CAPACITY gpm.
	@ 60 gpcd.	@ 144 gpcd.	@ 60 gpcd.	@ 144 gpcd.	
Drydock 3	50	121	700	700	305
Drydock 4	50	121	700	700	305
Drydock 8	188	450	355	355	900
System	288	691	1852	3468	1257

pumping cycle of about 2,500 gallons, the sewer piping must be filled up before the system exceeds full pipe capacities. The table shows that shoreside sewers are capable of handling the maximum 24 hour flow rates but may become pressurized during extreme peak flows for short durations.

5. SEWER PROCEDURES - NORMAL

Note: Standard connection and disconnection procedures are presently being developed for a PROCESS INSTRUCTION. Shop 99 has the primary responsibility for ship to sewer connection and disconnection. This shop's responsibility includes not only the shore side utility hookup but also ship side connection as the Shipyard takes full responsibility for all utility connections. The following discussion highlights some areas that should be included in the final instruction.

5.1 Connecting Ships

a. An air blow down and salt water flushing fitting is installed for all ship to shore connections. The fitting is 4 inch X 1½ X 1½ inch. The additional connections are for air and salt water flushing connections. With this fitting, all flushing and draining operations can be handled from the deck. Additional fittings are necessary to raise the deck riser discharge point above the passageway to the outboard rail. All these fittings are provided by shop 99.

b. Sewage transfer hose should be properly tied off and supported at each end to prevent accessive weight on the hose fitting and to prevent kinking.

c. Additional 90 degree elbows or 180 degree bends may be necessary to prevent kinking as the hose is connected to the sewer riser.

d. The pier sewer risers are not valved but have 4 inch plugs on drydocks 3 and 4. These sewers are continuous gravity systems and should not be pressurized. However, caution should be taken while removing these plugs.

e. To minimize the chance of an accidental sewage spill, be sure that the hose connection to the pier sewer is completed prior to the ship deck riser connection. This will prevent any accidental pumping by the ship through an unconnected hose.

f. The sewer on drydock 8 is a pressurized line. Although the sewer riser is protected by a check valve and gate valve, care should be taken when removing the plugs or disconnecting hoses as there may be some leak-by of the check valve. Also, the multiple connector of the riser may have two hoses connected to the same fitting. In this case, be sure both hoses have been disconnected or the ship deck riser closed before disconnecting from the pier riser.

g. All connections must be tagged to prevent unauthorized removal. In addition, the camlock locking ears should be banded closed to prevent them working loose.

5.2 Disconnecting Ships

Detailed procedures for disconnecting sewage transfer hose from ships and other vessels is described in NAVFAC MO-340, Chapter 8.

a. The flushing of the sewage transfer hose prior to the disconnection is all that is required to provide adequate hose cleaning. After the hose has been flushed and drained, the hose is ready for use after appropriate hydrostatic testing. The hydrostatic test limits for this hose should not exceed 100 psi. Experience has shown that a 10 minute salt water flush from the deck riser installed fitting and a three to five minute air blow down will usually do the job of cleaning. A second flushing and air blow down will loosen any solids trapped in kinked sections of the hose.

b. The hose should be disconnected from the ship riser prior to disconnecting at the sewer riser to prevent any accidental pumping through an unconnected hose.

5.3 Sewage Transfer Hose

There are several types of sewage transfer hoses available for large ships, submarines, and small craft. Ships with CHT systems are standard 4 inch camlock fittings on 4 inch hoses. Submarines use a $2\frac{1}{2}$ inch sewage hose with camlock fittings and small craft use $1\frac{1}{2}$ inch camlock fittings and hose. All sewage transfer hose has the camlock fitting which prevents its use in other utility services. The hose is marked "SEWAGE".

Sewage transfer hose comes in two designs. Originally, all facilities were outfitted with 4 inch collapsible hose, 50 feet, 130 pounds, manufactured according to MILSPEC-H-20176D. Five years of continuous service life for all hoses should be expected. According to design specification and MO-340, the hydrostatic test pressure for this hose is 100 psi.

The collapsable hose is suitable for all sewage transfer operations. However, the operator will note that it kinks easily and could shut off the flow from the ship. Additional care must be taken to prevent hose kinking. Additional 90 degree elbows, 180 elbows and temporary hose saddles and tie offs can be used to reduce the kinking. Ship hose connections should be regularly inspected by shop 99 to insure that kinking has not occured. As ships are pumping sewage, the collapsible hoses will pulse. This pulsing can quickly cause chafing of the hose and severe damage without proper precautions. This is particularly severe where the hose passes over concrete curbing.

Figure 5-1 shows a coil of the 4 inch collapsible hose. $2\frac{1}{2}$ inch sewage hose for submarines requires an adapter to fit the 4 inch sewer riser female fittings. Figure 5-2 shows this adapter in place.

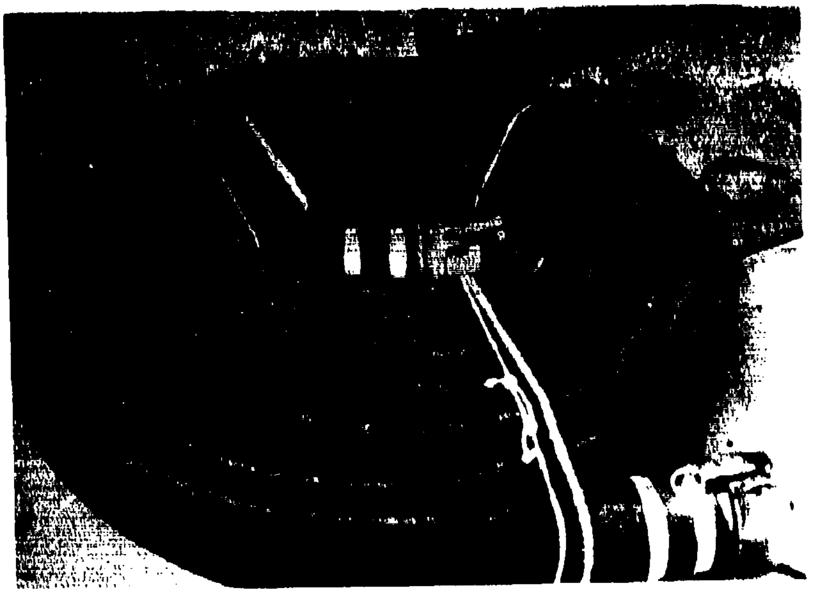


FIGURE 5-1. 4 Inch Sewage Hose

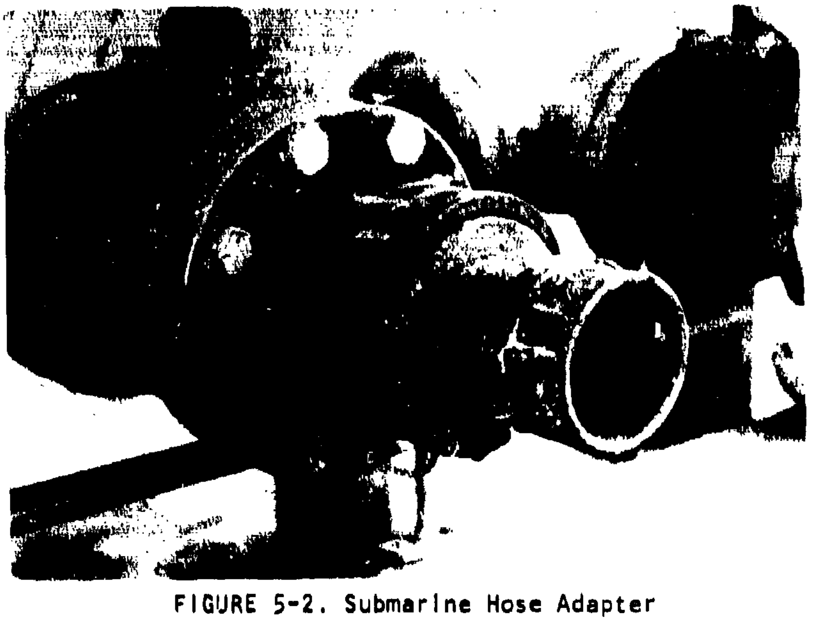


FIGURE 5-2. Submarine Hose Adapter

6. SEWER PROCEDURES - EMERGENCY

The sewer systems installed on the drydocks should have fewer operating problems than pier sewers. This chapter provides some guidance and discussion of typical sewer problems that may be encountered.

6.1 Sewer Line Break

The sewers for all the drydocks are above water level and any accidental damage causing a break in the line will not cause massive infiltration as with pier sewers. Damage to the suspended piping may occur from dropped material or from heavy equipment banging the drydock wall. The broken section should be isolated and repaired as soon as possible to restore the utility service.

6.2 Industrial Waste Intrusion

Pier sewer systems have been used as a convenient but improper way to dispose a variety of industrial waste from ships. This should be expected to continue even though the ship is in drydock. This waste may include a variety of oil wastes, paint and paint thinners, boiler cleaning compounds, and a variety of shipboard hazardous materials. Their detection is extremely difficult and are usually first noticed in the wet well of the pumping station. Once discovered, they must be traced up the sewer line and their source from either an industrial shop or ship sewer must be determined. If the intrusion of hazardous material is noted, a decision must be made as to whether the Portsmouth Treatment Plant can handle the quantity of industrial waste. Close contact should be maintained with the facility so that these determinations can be quickly and fairly made. Industrial waste material and flammable liquids can enter the shipyard sewer system not only through sanitary drains but through some storm drain cross connections. Until these cross connections have been isolated, open area hazardous waste spills may quickly reach the sanitary sewer.

6.3 Sewage Spill Procedures

Sewage spills occuring in open areas along the drydock could most likely occur from sewage hose failure, improper hose connection procedures, or equipment damage to the sewer riser fittings. The first concern in responding to a sewage spill is to keep unnecessary personnel away from the area. Stop the source of the spill and flush down the area as quickly as possible into a sanitary storm drain. More detailed procedures are discussed in the following Health and Safety chapter.

6.4 Emergency Notifications

Shop 99	Tele:	-5895
PWD Maintenance		-3401
Portsmouth Sewage Treatment Plant		393-8413

7. HEALTH AND SAFETY

The operation and maintenance of ship to shore transfer systems is no more hazardous than other waterfront operations. The safety and health precautions for this work require mostly a common sense approach. Historically, workers in the maintenance of sewer systems and the operation of treatment plants have enjoyed an excellent health and safety record. Workers with the ship to shore sewage transfer system should be aware of the following health and safety precautions.

7.1 Health Precautions

Clothing. The following list of clothing is suggested for most routine operation and maintenance procedures. Clothing should be washed frequently and a spare set of work clothes or coveralls available in a locker to provide a fresh change of clothing if necessary. No special segregation of this clothing is necessary for washing. It can be washed with regular home laundry.

Hardhat. An approved hardhat is required for all work pier side and this safety procedure should be carried over to the maintenance workers of the shore collection system.

Work Clothes. Regular work clothes or coveralls are all that is required for exterior clothing and working with sewage transfer hose. Coveralls and waterproof aprons are recommended when cleaning hoses or working with wet equipment.

Rubber Gloves. A short pair of heavy rubber glover should be worn while handling sewage hose equipment.

Work Shoes. Steel toed work shoes must be worn at all times when handling sewage transfer hose and fittings as well as performing maintenance tasks. Steel toed rubber boots should be worn while making hose disconnects or when in wet sewage environments.

Washing Up. This is the most important category of health precaution to prevent unsanitary conditions. Workers must remember to wash hands and face after handling sewage equipment prior to eating, smoking, or drinking. This must become a regular habit of all sewage transfer workers. Hand washing and shower facilities are available in the hose cleaning and storage building.

Health Records. The dispensary should be requested to mark the health records of personnel working with sewage transfer equipment with the following: "Occasional Contact With Sewage".

Shot Records. BUMED has recommended that the normal series of innoculations be maintained for all personnel working with sewage equipment. These are tetnus, typhoid, and polio. Innoculations, if kept up to date, should provide a sufficient level of protection to the workers. Workers should be particularly careful with open cuts and must be required to prevent infection by adequately cleaning any wounds. The dispensary should be visited for treatment of any infections, sewage contact with eyes, or any abnormal health condition that may occur.

Potable Water Connections. Personnel working with sewage transfer equipment must not subsequently make potable water connections. If it is necessary to connect to a water hydrant to hose down an area of a sewage spill, a different worker should be called to make the connection and handle the fresh water hose.

7.2 Safety Precautions

Pier Operations. The shore crew for sewage transfer hose connections and disconnection procedures requires at least two men. Hardhats are necessary while on the piers, particularly when the hose is raised and lowered to the ship.

Manhole and Wet Well Entry. The following equipment is necessary for the safe entry into a manhole or sanitary wet well.

1. Safety Barricade

2. Safety Harness and Life Lines
3. Ladder
4. Explosion Proof Lighting
5. Manhole Lifter
6. Portable Ventilating Blower

A gas-free permit is to be issued prior to entering a manhole or sanitary wet well. It should be remembered that the ladder runds installed in manholes are particularly subject to corrosion because of the corrosive atmosphere of the salt water sewage in these systems. These ladder runds should be inspected for deterioration and tested with a hammer. If necessary, the manhole should be entered by a supplemental portable ladder if there is any question.

The presence of explosive or toxic gasses in an oxygen deficient atmosphere should be of constant concern to sewer maintenance workers. These gasses cannot be detected by smell and must be regularly tested by a proper sampling meter. If there is any doubt as to the condition of the atmosphere within a confined manhole, forced ventilation with a blower should be provided.

7.3 Sewage Spill Clean Up

Sewage spills are most likely to occur around the sewer connections risers. These are usually the result of insufficient hose drainage prior to disconnection, leaking hose gaskets, hose rupture, or a ship inadvertently pumping throug a disconnected sewage hose. The basic procedure is to flush the area clean. The following procedure should be used and adapted for various sizes of sewage spills as necessary.

--Secure source of spill.

--Close off area to unnecessary traffic and personnel.

--Flush area with fire hose (a seperate non-contaminated man should be called in to make hydrant connection and handle the hose) - salt water is preferred.

--Use disinfectant or detergent to cut odor or grease if needed. (Use a dry phenolic compound or any stock detergent.)

--Flush area again

--Open area to regular activity.

The disinfectant in MO-340 is a disinfectant, germicidal, fungicidal, concentrate (phenolic dry type) stock 6040-00-753-4797. Chlorine (HTH) should not be used around piers or other areas where it may come in contact with grease or oil.

8. MAINTENANCE

The maintenance program of the sewer system at the Naval Shipyard has been limited to primarily regular inspections, with most maintenance and repair work performed by contract. The sewers installed at the drydock for sewage have certain characteristics that may add to the need for further inspections and regular maintenance. The following sections discuss recommended maintenance procedures.

8.1 Regular Maintenance

Regular daily inspections are necessary to insure continued trouble free operations of the drydock sewer systems. It is recommended that the following daily inspections be made:

a. Shop 99 - Sewage transfer hose from ships pumping into the sewer system should be inspected for tight camlock connections, leaks around gaskets and fittings, kinks in the collapsible hose, excessive weight from catenary bends, and contact with hot steam lines and hose chafing.

b. Shop 99 - While ships are pumping into the sewer, a visual inspection of the exposed piping should be made to observe for any leaks at flanges or welds.

c. Shop 99 - Check hose connections for temporary service identification tags and renew as required.

d. PWD - The pumping station sewage wet well should be examined for evidence of oil or excessive grease buildup. If excessive oil or hazardous chemicals are present, sewer manholes should be examined to identify the source and isolate the problem.

At least monthly inspections should be performed by PWD to examine the sewer system by lifting manhole covers to look for signs of sewer blockage, contamination, and sludge buildup. This is particularly important for the ship sewage receiving sewers because of their relatively flat grade and low drainage velocities. These low velocities will cause rapid solids buildup. Cleanout fittings are provided in the suspended piping to provide for additional sewer line flushing.

8.2 Regular Sewer Maintenance

The majority of the sewer system piping at the Norfolk Naval Shipyard has full pipe flow velocities less than the design standard established in NAVFAC DM-5 of 2.5 feet per second. As a result, these portions of the sewer system (see Table 2-1) may quickly accumulate solids as a result of buildup from the low flow rates of sewage. As the frequency of the use of these sewers increases, at least quarterly inspections of these sections of the sewer systems will be necessary to be aware of the sludge buildup rate. As solids buildup occurs, line flushing and cleaning will be required. The sewer pipe is equipped with cleanout access points. Flushing and cleaning operations should be conducted from the most upstream portion of the system then towards the pumping station.

Extreme care should be taken during excessive cold weather periods which may cause sewer line blockage from ice formation. CHT systems regularly dose the sewer with only about 300 gallons of sewage from one ship pump firing. This dosing will occur infrequently about once an hour, particularly during the coldest hours in the early morning. Since this flow is not constant, it may cause rapid ice buildup in the sewer line. Until sufficient experience with cold weather operations is gained, extreme care should be taken to avoid the formation of ice within the sewer line.

The pier piping should be inspected yearly for damage and the condition of exterior coating. The sewer risers, along with camlock fittings, gaskets, plugs, and manhole covers should be inspected and maintained as necessary. Camlock gaskets in the sewer riser connection and hoses require replacement about yearly to maintain a tight and leakfree connection.

8.3 Hose Maintenance

Regular maintenance procedures for sewage transfer hose are outlined in MO-340. Normal flushing of sewage hose with ship saltwater flushing connections will provide sufficient cleaning of the sewage hose prior to disconnection. The most important maintenance function to be performed on the hose is the routine inspection prior to hose storage. Evidence of leaks or excessive abrasion should indicate that the individual hose should be removed from service and the bad sections removed by shortening the hose length.

Hydrostatic testing of sewage transfer hose should be performed within the pressure limits of the hose specification. The sewage transfer hose centrally procured under MILSPEC-H-20176 should be hydrostatically tested to 100 psi.